

# LICENTIATE'S THESIS

ANDI MAWAZO MWEGERANO

Andi Mawazo Mwegerano

HANDLING CUSTOMER COMPLAINTS DURING THE AFTER-SALES SERVICE:  
MOBILE TERMINALS

This thesis is submitted in partial fulfilment for the degree of Licentiate of Science in Technology  
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Supervisor

Instructor

Second examiner

Professor Jyri Hämäläinen

Emeritus Professor Sven-Gustav Häggman

D.Sc. (Tech.) Timo Smura

Author:	Andi Mawazo Mwegerano
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Supervisor:	Professor Jyri Hämäläinen
Instructor:	Emeritus Professor Sven-Gustav Häggman
Second examiner:	D.Sc. (Tech.) Timo Smura
<p>This thesis examines how customer complaints regarding mobile terminals are handled and managed during the after-sales phase. Mobile communication devices have become essentials of daily life in most parts of the world. The annual increase in the number of mobile handsets produced and sold brings challenges in maintaining standards of performance in accordance with customer expectations. Such expectations give rise to the issues of device quality and service quality. By reviewing existing literature, four published articles, and a proceedings paper, this thesis analyzes the best strategy for improving the handling of customer complaints regarding mobile terminals. The case studies in the articles employ different statistical methods for analyzing different variables and parameters that affect customer satisfaction, loyalty, and retention. The articles focus only on the customer-raised technical problems that are encountered in mobile terminals deployed in the field. The main customers in the current thesis are authorized service vendors that interact with terminal end-users. The statistical methods in the aforementioned articles are used to create a model that is useful for significantly optimizing problem resolution time. Results show that the perceived quality of problem resolution is closely associated with the perceived quality of problem description and perceived quality of the time spent in resolving problems. On the basis of the findings, several managerial implications are established. As a rule, training on new products should be provided to internal and external service staff to effectively manage the problems raised by customers in the field. Communication between mobile manufacturers and authorized vendors should be maintained on a regular and systematic manner to capture the business opportunities available to both parties. Such opportunities can be evaluated through panel analysis.</p>	
<p><b>Keywords:</b> Customer complaints, Complaint handling process, Complaint management, Customer satisfaction, Quality of service, After-sales service, Statistical modeling</p>	

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## LIST OF PUBLICATIONS

This thesis features the core analysis built from existing literature, four peer-reviewed journal articles, and one proceedings conference article.

- [P1] Mwegerano, A. et al. 2008. Characterization of resolution cycle times of corrective actions in mobile terminals. *Quality and Reliability Engineering Internal Journal*, 24 (1), pp. 613–621
- [P2] Mwegerano, A., Kytösaho, P., & Tuominen, A. 2007. Opinion survey on the quality of corrective actions and time provided to customers versus quality of issues description of issues raised in mobile terminals. *ICEP 2007 Proceedings*, pp. 343–346
- [P3] Mwegerano, A. & Ollikainen, T. 2013. Predicting customers issues resolution times in mobile terminals. *International Journal of Computer and Information Technology*, 2 (3), pp. 417–423
- [P4] Mwegerano, A. & Sippola, J. 2014. Authorized service vendors in mobile terminals. *iBusiness Journal*, 6 (1), pp. 18–28
- [P5] Mwegerano, A. & Ollikainen, T. 2014. Evaluating challenges and competence for employees in a chain providing corrective actions to customers with mobile terminals. *Archives of Business Research (ABR)*, 2 (1), pp. 10–22

## **AUTHORS' CONTRIBUTIONS**

- [P1] The first author formulated the research question and established the model for the customer issue escalation process. He gathered data from an in-house-developed database tool called GENIUS. Together with a statistician, the second author researched suitable methods for analyzing the data, analyzed the data and findings, and drew conclusions together with the other co-authors. The first author prepared and presented the original version of this paper at the International Conference on Electronics Package (ICEP) in Tokyo, Japan (April 13–15, 2005, pp. 66–70), during which he received feedback on further developing the manuscript into a full article. The third and fourth authors served as mentors for this research. The first author prepared the manuscript of this work for the *Quality and Reliability Engineering International Journal* (2008, 24, pp. 613–621). This paper is included in the doctorate dissertation done in the end of May 2014 at Turku University.
- [P2] The first author established the research topic and collected material using a database tool built in house. He compiled the questionnaires, which were sent by e-mail to the different service personnel responsible for resolving customer complaints and the service divisions from where the complaints originated. The first author was mentored by a statistician in terms of the best method for analyzing the data, and together with the co-authors, analyzed such data. The first author also composed the entire article and presented it at ICEP-2007 held in April 10–20, 2007.
- [P3] The first author formulated the research question and established a model for the customer issue escalation process. The author collected data from GENIUS. Together with statisticians, the co-authors researched suitable methods for analyzing the data and compiled the findings and conclusions. The first author wrote the article and submitted it to a peer-reviewed journal: *International Journal of Computer and Information Technology*, 2 (3), May 2013, pp. 417-423.
- [P4] As an expert on the process employed by authorized service vendors, the first author composed the research questions, designed the study, collected data through an interview survey, compiled descriptive statistics, and composed the article. With the co-author, he then compiled inference statistics. All the authors contributed equally by reviewing the entire study for quality and contribution to knowledge. The first author compiled the work and presented it to a peer-reviewed journal: *iBusiness Journal*, 6 (1), pp. 18–28).



- [P5] The author generated the topic and web questionnaire for distribution to service employees working in the chain to implement corrective actions for the problems raised by customers. He established the conceptual model of the research area, as well as the scope of the work. With the co-author, he identified the best method for analyzing the data. Both the authors derived the findings, the statistical model and drew the conclusions. The first author composed and prepared the article for publication in a peer-reviewed journal: *Archives of Business Research (ABR)*, 2 (1), pp. 10–22.

## LIST OF ABBREVIATIONS AND ACRONYMS USED

Ad SS	Adjusted Sum of Squares
Adj MS	Adjusted Mean Square
ASV	Authorized Service Vendors
BG	Business Group
BU	Business Unit
CA	Corrective Action
CAP	Corrective Action Process
CC	Customer Care
CDMA	Code Division Multiple Access
Coef.	Coefficient
CPM	Care Project Manager
CRM	Customer Relationship Management
CS	Customer Satisfaction
CSAC	Country Sales Area-Care
DF	Degree of Freedom
DIKW	Data, Information, Knowledge, Wisdom
ES	Employee Satisfaction
F	F-Distribution Variable
FFR	Field Failure Rate
FSQ	Functional Service Quality
GENIUS	Global Exchange for Nokia Product Information and End-User Support
GLM	General Linear Model
GSMA	Global System for Mobile Communications Association
HW	Hardware
iBI	Issue Business Impact
iCA	Issue Corrective Actions
ICEP	International Conference on Electronics Packaging
ICT	Information and Communication Technology
iRT	Issue Resolution Time
iTA	Issue Technical Area (Fault Symptom)
ITU	International Telecommunications Union
L	Level
LEARNT	Listen, Empathize, Ask, React, Notify, Take Action
MS	Mean Square
μBGA	Micro Ball Grid Array
MT	Mobile Terminal

nWOM	Negative Word of Mouth
OEM	Original Equipment Manufacturer
P	Probability
PC	Program Center
PCA	Principal Component Analysis
P-QopRT	Perceived Quality of Problem Resolution Time
P-QopS	Perceived Quality of Problem Solution
P-QopDes	Perceived quality of problem discription
pRT	Problem Resolution Time
pS	Problem Solution
Q	Question
QoS	Quality of Service
RAR	Registered Articulation Rate
R&D	Research and Development
RQ	Research Question
RRP	Recommended retail price
RSAC	Regional Sales Area-Care
S	Standard error of the regression or standard error of the estimate
SA	Sales Area
SC	Service Chain
SE Coef.	Square Error Coefficient
Seq SS	Sequential Sum of Squares
SIPOC	Supplier, Input, Process, Output, Customer
SL	Service Level
SS	Sum of Squares
SWP	Software Platform
TARP	Technical Assistance Research Programs
TAT	Time for Average Turnaround
TU	Time Unit
TSQ	Technical Service Quality
WOM	Word of Mouth
Z	Z-Score (standard normal variable)

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# **1. INTRODUCTION**

The literature supports the fact that research on after-sales complaints is limited—a deficiency that is even more pronounced in the mobile terminal (MT) industry. Given this backdrop, the current thesis examines the complaint management approach employed in an MT manufacturing company. Given that MT subscriptions have tremendously grown since the mid-eighties, the number of complaints by MT end-users has grown as well. These complaints are due to changes in technologies, applications, usability, and user interfaces, among other factors. Despite the increase in the number of mobile phones since the early 1980s, there exists little information and communication technology (ICT) literature about how after-sales service recovery is handled or about its effects on the business of an MT manufacturer. This scarcity can be partly attributed to business security reasons and to a combination of other factors unknown to researchers. The scarcity of the literature motivates this thesis to contribute to this important research domain and help customers understand how their complaints are usually handled, specifically in the after-sales period of the MT industry.

MTs have become necessary daily working tools, especially in Western countries but with the rest of the world rapidly following suit. As the technology for MTs advance, more challenges will be encountered in after-sales service recovery. This thesis draws knowledge on after-sales customer issue recovery from the marketing and customer relationship (CRM) literature and contributes to insights on after-sales customer issue recovery for MTs in ICT. The established statistical models in the articles reviewed in this thesis also expand existing knowledge on the after-sales process that underlies the resolution of customer issues in the field of mobile phone manufacture and sales.

## **1.1 Background and Motivation**

The tremendous increase in MT subscriptions since the mid-eighties has given rise to the growth of complaints from MT end-users. As previously stated, these complaints originate from changes in technologies, applications, usability, and user interfaces. ITU 2013 predicts that in 2014, the number of active MT users will reach 7.3 billion relative to a global population of 7 billion. More than 100 countries have a number of MT accounts that exceed their population sizes (ITU 2013 Mobile World Congress, 2013). The huge annual growth in MTs brings forth increasing problems that need to be resolved in a timely and efficient manner by manufacturers. This research is devoted to examining best practices by analyzing existing literature and the case studies conducted by the author on how to handle the problems raised by customers who own MTs. Substantial material can be found in marketing after-sales literature, specifically on how to

address customer-raised problems, but little research has been devoted to how problem handling in MT after-sales stages is analyzed despite the rapid growth of the industry.

The reviewed articles focus on how to handle the customer-raised technical problems encountered in MTs. Specifically, the articles revolve around strategies for responding to these problems in an effective and timely fashion. In terms of problem type, the articles examine the technical issues raised by customers with regard to an ASV with which they interact. Communication between authorized service vendors (ASV) and product manufacturers is deemed important for the mutual growth of businesses. Thus, communication between MT manufacturers and ASV is also explored in this work. This thesis is limited to investigating the handling of problems that are encountered and raised by customers and does not examine the logistical component of after-sales stages in the MT industry. In this work, problem resolution time is denoted as pRT and problem solution is denoted as pS.

## 1.2 Research Questions

This dissertation focuses on managing customer complaints/problems in a support chain network. The research questions (RQs) center on the technical issues raised by customers and are formulated on the basis of four peer-reviewed articles and one conference proceedings paper. One of the most important factors that affect customer loyalty is the manner by which a company or a service firm resolves the problems encountered as customers use certain products or services (Kasper & Lemmink, 1989). The service performance of a company is related to customer loyalty (Heskett et al, 1994). pRT is considered the most important service item (Kasper & Lemmink, 1989). Customers expect a satisfactory solution to their service problems (e.g., Heskett et al, 1994). Accordingly, this research develops four RQs regarding the perceived quality of problem resolution (P-QopS) and perceived quality of pRT (P-QopRT), the factors that affect P-QopS and P-QopRT, the voice of ASVs, and competence in the service chain (SC). The urgency of each RQ is discussed below.

### **RQ1: How can pRT be optimized?**

This RQ is deemed important because it deals with the optimization of quality process handling. Under such a process, pRT can be optimized through the identification of critical problems and corresponding best solutions. Optimizing pRT is contributory to customer satisfaction (CS).

### **RQ2: What are the factors that affect P-QopS?**

P-QopS is a crucial factor that influences CS. An important requirement, therefore, is to investigate the factors that affect P-QopS. These factors may be enhanced and consequently contribute to high P-QopS and vice versa.

**RQ3: Can pRT be predicted?**

This RQ is relevant to customers and ASVs or troubleshooters in MT manufacturing companies. If pRT can be predicted, customers who experience MT-related problems can be informed about when to expect a solution to their problems. A customer can also decide on whether to wait or opt for another solution or demand to have his/her MT exchanged with a better unit. Under this question, variables that may be used to build a pRT model are investigated.

**RQ4: How can the voice of the ASVs of MTs be measured?**

An essential component is strong communication and trust between MT manufacturers and ASVs because these influence the manner by which both parties transact with each other. This question investigates how a good relationship between the two parties can be achieved to steer their businesses toward a win-win situation.

**Table 1.** Research questions of the reviewed publications

Question/ Publications	RQ1	RQ2	RQ3	RQ4
Publication 1	5	4	4	3
Publication 2	4	5	3	3
Publication 3	3	4	5	2
Publication 4	2	4	4	5
Publication 5	3	5	3	4
Importance to question (5 = High, 1 = Low)				

All the RQs are answered by reviewing the aforementioned published articles and proceedings articles as shown in Table 1. The detailed responses are provided in the conclusion chapter.

### 1.3 Research Approach and Methodology

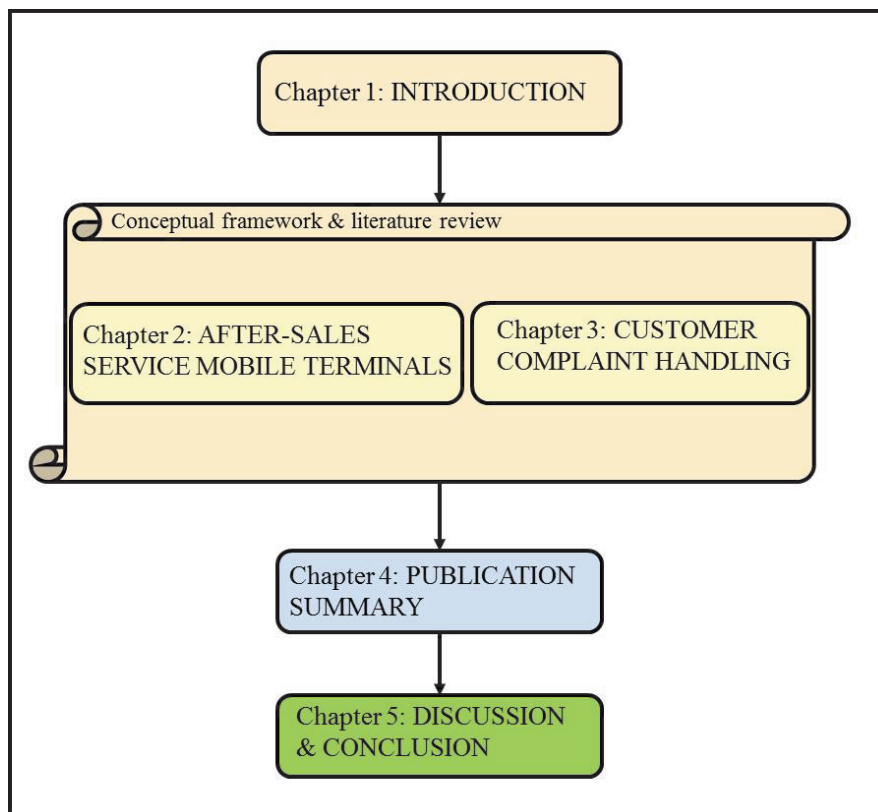
As stated earlier, this work analyzes four published pre-reviewed articles and one conference proceedings paper, for which quantitative and qualitative analyses are employed. The articles are based on different collected data. Figure 1 illustrates some of the research processes (written in bold typeface) employed in the articles. Data are collected from an in-house database and through surveys.

The articles apply mixed-method analysis (i.e., quantitative and qualitative methods) and can be regarded as case studies because they all focus on one company.



## 1.4 Thesis Outline

This thesis is organized into two parts: (1) the introductory section and (2) a section devoted to the original published articles. The document is organized into five chapters, of which three falls under the introductory section and the rest are structured under the empirical studies, discussion, and conclusion sections. Chapter 1 is the introduction, which presents the motivation, RQs, and the research method. Chapter 2 explores the importance of after-sales activities and processes in the MT industry. The concepts of service quality and CS are introduced through a discussion of the literature. The chapter also discusses a practical example of how after-sales service in MT is implemented through ASV. On the basis of theoretical assumptions, Chapter 3 examines the process through which customer problems are handled in a general manner. A practical example of how customer complaints are handled is presented to support the theoretical discussion in the chapter. Chapter 4 presents a summary of the empirical studies conducted for the five articles. Chapters 5 discuss and conclude the thesis by providing the responses to the RQs and the theoretical and managerial implications of the research. Limitations and suggestions for future research are outlined at the end of the thesis. Figure 1 shows the thesis layout.



**Figure 1.** Thesis layout.

The conceptual framework and literature review cover two chapters (Figure 1).

## **2. AFTER-SALES SERVICE: MOBILE TERMINALS**

This chapter discusses and introduces after-sales services for MTs, specifically mobile phones. The discussion revolves around one MT manufacturer, making this company the studied case. This chapter includes a discussion of the activities carried out by the MT manufacturer and an ASV. Quality and CS are also briefly explored.

The AS services discussed in this thesis are limited to the technical support provided by the studied company. Logistic and other components of customer care in post-sales periods are beyond the scope of this work.

### **2.1 Definition and Importance of After-Sales Service**

After-sales services refer to the different practices implemented by a company in handling the problems concerning a product after it has been launched in the field (Patelli et al, 2004). These practices are carried out to make sure that customers are satisfied with the products or services of a company; this way, the company excels in terms of after-market performance (Cohen et al, 2006). AS activities have become increasingly important as sources of differentiation and profit for manufacturers. A shift has therefore taken place in the after-sales field, with focus transitioning from a traditional product-centric view to a more innovative customer-centric perspective (Gaiardelli et al, 2007). The importance of after-sales services is demonstrated by the profits that they produce, and such profits are often higher than those earned from product sales; the service market can be four or five times more profitable than the product market (Bundschuh & Dezvane, 2003; Sacconi et al, 2007) and may generate three times the turnover of original purchases during a given product's lifecycle (Alexander et al, 2002; Wise & Baumgartner, 1999). After-sales activities can include training on product usage, software updates, provision of spare parts for repair, guarantees, and warrant policies for replacement in case of damaged or faulty products (Levitt, 1983). Automated customer services, such as 24/7 services (including, for example, a website for feedback provision or forum discussion among customers), are also a component of after-sales support.

AS services play a significant role in CS and customer retention (CR) (Lovelock & Wirtz, 2007). Customers are satisfied and businesses earn profits when products and services meet or exceed consumer needs and expectations; for example, when customers are very satisfied, they can easily become loyal customers (Heskett et al, 1994).

## 2.2 Service Quality and Customer Satisfaction

CS and service quality (SQ) significantly differ. The latter pertains to long-run attitudes regarding overall evaluation, whereas CS represents a short-term, transaction-specific judgment (Rigopoulou et al, 2008).

In the literature, “customer satisfaction” is defined in many different ways. Broadly, it refers to measuring how the products and services supplied by a company satisfy or exceed customer expectations (Edvardsson, 2000). Farris et al. (2010) define CS as the “number of customers or percentage of total customers, whose reported experience with a firm, its products, or its services (ratings) exceeds specified satisfaction goals.”

Within an organization, employee satisfaction (ES) exerts effects on external CS. Internal ES is positively or negatively associated with CS (George & Brief, 1992; Tett & Mayer, 1993; Heskett et al, 1994; Johnson, 1996; Brooks, 2000; Zigarmi et al, 2009; Farris et al, 2010). The higher the ES, the higher the CS. An important requirement for a firm, therefore, is the effective management of CS. To achieve this goal, a reliable measurement matrix for CS is required to maintain a firm’s business performance. A typical practice is to administer user surveys to obtain feedback from customers on whether products or services have satisfied or exceeded their expectations. “When customers have high expectations and the reality falls short, they will be disappointed and will likely rate their experience as less satisfying” (Farris et al, 2010).

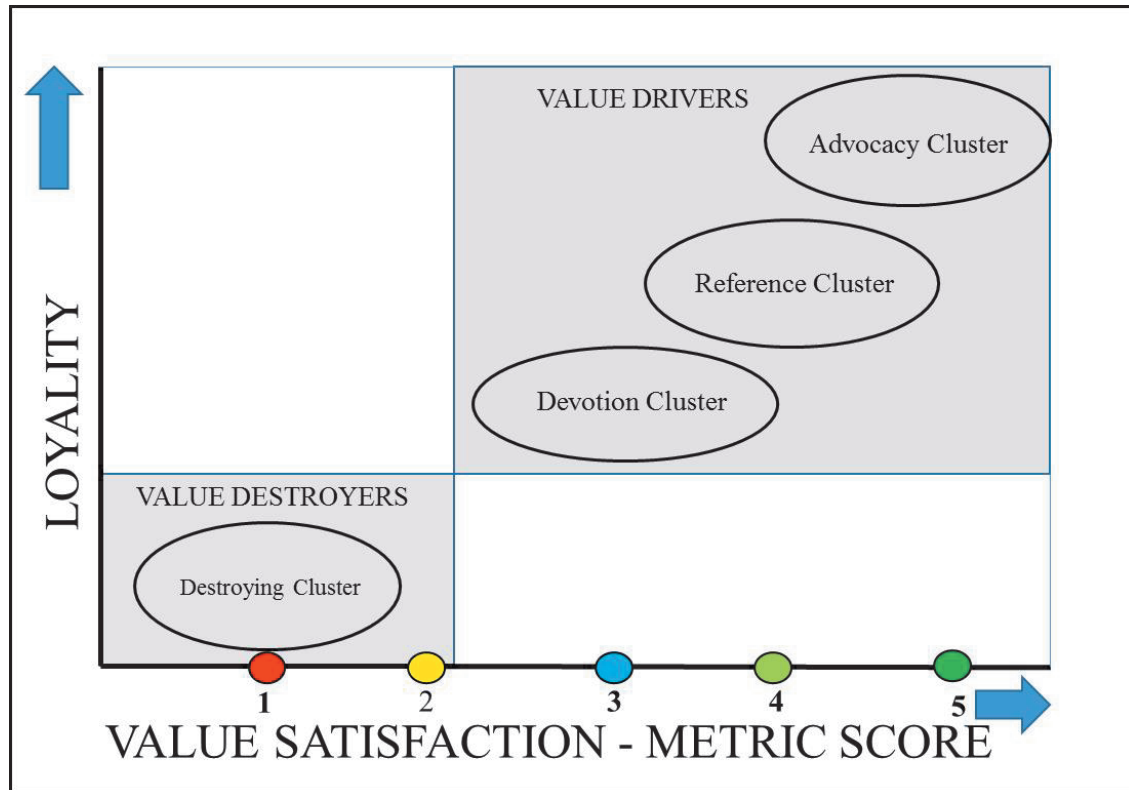
SLC consultants, Inc. built an AS framework that examines the costs that customers have to bear when equipment fails, describes a framework that helps manufactures characterize the most cost-effective service strategies for different customer segments, and determines how these strategies should influence equipment design. The framework is used to predict how service strategies must change in response to new technologies and developing customer needs (Lele, 1997).

Caruana et al. (2000) states that “the level of CS is the result of a customer’s comparison of service quality expected in a given service encounter with perceived service quality. This implies that satisfaction judgments require customer experience while quality does not.”

### 2.2.1 Measurement of Customer Satisfaction

In principle, firms employ two ways of measuring CS. (1) They use longitudinal surveys for internal distribution and administration to external customers. The results of data analysis indicate whether employees have a positive experience of a firm’s products and services and whether external customers have had their expectations satisfied or exceeded. (2) The second metric is related to CS, i.e., the willingness of customers to recommend a brand, product, or service to

friends or relatives. This group is referred to as value drivers or “apostles,” a term coined by Cook (Hesskett et al, 1994) (see Figure 2).



**Figure 2.** Relationship between customer value satisfaction measure and loyalty (adapted from Shaw, 2007).

Individuals who rate their satisfaction level as 1 are referred to as value destroyers. They normally spread negative word of mouth (nWOM) to their friends, relatives, and wherever they have an opportunity to do so (Richins, 1983; Wangenheim, 2005). Researchers have found that the effects of satisfaction are mostly strongly realized at extremes on a five-point scale (refer to Figure 2). Customers who rate their satisfaction level as 5 are likely to repurchase a company’s products or services (Heskett et al, 1994; Hallowell, 1996).

Parasuraman et al. (1985–1988) developed a CS measure for a service by using the gap between customer expectation of performance and perceived experience of performance. The measure of this gap is objective and quantitative in nature.

### **2.2.2 Gap between Technical Service Quality and Perceived Functional Service Quality**

Technical service quality (TSQ), as perceived by customers, may differ from the quality actually delivered. This difference spells the distinction between TSQ and functional service quality (FSQ) or the quality perceived by customers. FSQ is based on a customer's perceptions; it is therefore extremely subjective and includes all clues (e.g., how a company will perform, how the customer will be treated, etc.) that the customer picks up during a business deal (Caruana et al, 2000).

TSQ is based on the ability of people and service systems to deliver good (professional) quality—another aspect of CS that should be closely monitored. The capability of a manufacturing company to implement a monitoring process is one of the basic principles in managing quality. In the service industry, process capability is considered limited because of the fact that the variability of processes is taken for granted.

Parasuraman et al. (1985) explains the gap between expected service quality (i.e., TSQ) and perceived service quality (i.e., FSQ) by developing a “gap model,” in which four factors are identified as causing the gap:

1. The first factor is the disparity between the perceptions of management regarding customer expectations and the expectations of customers regarding a particular service. “For instance, field engineers know very well what their customers want, but this kind of information is not always fed back to the company, with the result that management has an inadequate idea of customer expectations. In the long run, this may lead to role conflict at the level of the field engineer. Market research can help to close this gap.”
2. The second refers to the disparity between the understanding of management regarding customer expectations and the “translation of those perceptions into service quality specifications. The quality specifications (which can be enshrined in quality systems such as ISO 9000) are not fine-tuned to customer expectations.”
3. The third factor has to do with the divergence “between service quality specifications and the actual service delivery. Lack of resources can make it impossible for employees to meet the quality specifications. Other factors contributing to the closing of this gap are teamwork, employee-job fit, technology-job fit, perceived control, supervisory control systems, role conflict and role ambiguity.”



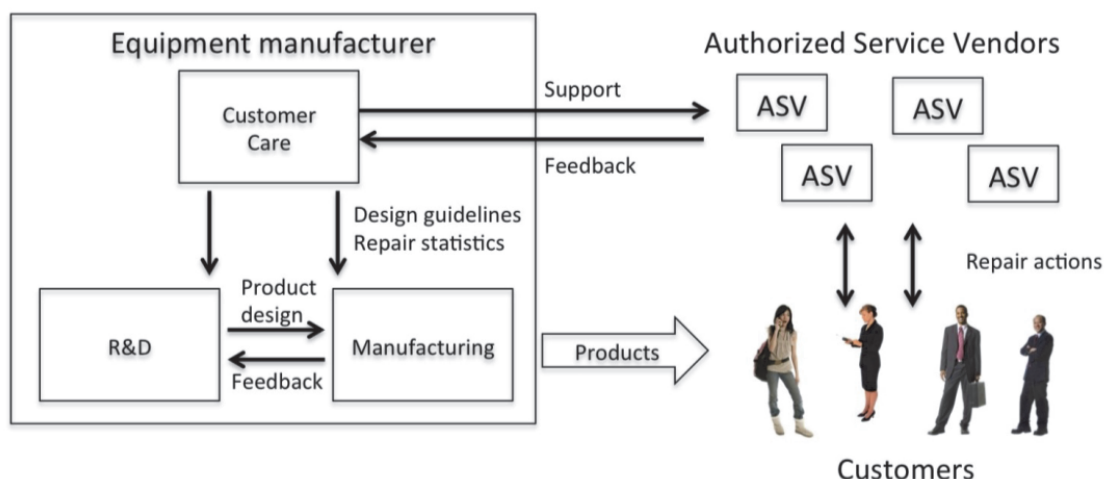
ASVs in Europe, the success of an MT manufacturer's business is regarded as the success of an ASV's business and vice versa (Mwegerano & Sippola, 2014a). The mutual success of the parties constitutes a win-win situation.

When an MT end-user experiences problems with a product and fails to independently resolve the issues, then he/she contacts the nearest ASV for service provision. The ASV performs a diagnostic analysis to identify the root cause of the problem and resolves it accordingly. The ASV estimates service costs, which are paid by the customer if the device is no longer covered by warranty. If the problem entails a long time to resolve, then the ASV exchanges the customer's unit with a new one or lends him/her a device for temporary use. An unresolvable problem is escalated to a higher authority (e.g., a manufacturer) through a defined process.

The ASV orders spare parts for repair and swaps phones or modules to replace defective units. Terminals that are covered by warranty are repaired free of charge, with all fees forwarded to equipment manufacturers through an in-house tool. The ASV manages the technical problems reported by customers via a fault management process and implements metric quality policies for in-house repairs. It also establishes cost estimates and service time (i.e., turnaround time (TAT)) for repair. The ASV trains other technicians to make sure that they competently complete their daily work.

Throughout the process, the customer experiences the service and is exposed to different aspects of his/her interaction with the ASV, such as the quality of service availability, TAT, cost, and communication.

### 2.3.1 Manufacturer or Product Provider






**Figure 4.** Block diagram of the equipment manufacturer and its organization (Mwegerano et al, 2014a).

As demonstrated in Figures 3 and 4, the MT manufacturer prepares product training for ASVs and mega-customers before product launch to enable servicing of the MT product in the after-sales phase. The MT manufacturer provides service manuals and a service repair policy, as well as addresses issues regarding the warranty process. Mega-customers receive their localized products in accordance with their order requirements.

The most important after-sales driving factors that ensure CS with a product or service provider are costs, quality of service (QoS), and speed of service. Customers provide feedback to an ASV or directly to an MT manufacturer, which then incorporates the feedback in the design of succeeding manufactured products.

### 2.3.2 Authorized Service Vendors

ASVs are selected by MT manufacturers with the aim of resolving most of the technical problems raised by end-users or mega-customers. An ASV is the main channel through which customers' voices and complaints are heard by an MT manufacturer. ASVs are grouped according to their ability to handle the problems encountered in MTs. As an example, Figure 5 shows a four-level division of how MT-related problems are handled. The problems are resolved through product repair or software or hardware upgrades.

LEVEL4	LEVEL3	LEVEL2	LEVEL1
REC & RSC	Service Supplier	Club Nokia Service Point / Service Point	Club Nokia Service Point / Service Point
Level 3 + Fault analysis for special dedicated products and special requirements (analysis, reporting) for new products	Level 2 + Full component level repair incl. all tuning possibilities (also with BGA soldering equipment)	Level 1 + Change of electromech. components (which are soldered and no tuning is needed)	Mechanical repair and software update/upgrade (no soldering, no tuning)
			

**Figure 5.** Authorized service vendors grouped by levels (Mwegerano et al, 2014a).

A level 1 workshop carries out simple mechanical repairs and updates/upgrades of mobile phone software.



Level 2 workshops on top of level 1 duties, carry out repairs that do not require tunings and updates/upgrades of mobile phone software.

Level 3 workshops repair Nokia mobile phones down to a component level. This task includes logical fault finding, measurements, tunings, and updates/upgrades of mobile phone software, as well as possibly changing micro ball grid arrays ( $\mu$ BGAs). The workshop keeps a stock of spare parts needed for repairs and an appropriate amount of phones and accessories for swapping. Level 3 workshops can function as a backup workshop for levels 1 and 2 workshops with all the relevant technical support, including training.

Level 4 workshop is able to carry out all possible repairs to Nokia mobile phones down to the component level including fault analyzing, logical fault finding, measurements, tuning, update/upgrade of mobile phone software and changing  $\mu$ BGA's. Being involved in CE process at earlier level than other partners for evaluation of tools and design for service. Level 4 workshop will function as a backup workshop for level (1, 2) 3 workshops if necessary with all relevant technical support including training.

## 2.4 Summary

After-sales services are sources of originality and benefit from value creation through new managerial approaches to building competitive advantage and improving CS. Many manufacturers have realized that the growth achieved from physical product sales has gradually become limited. The shift to an after-sales economy has driven a refocus of manufacturer strategy. After-sales service represents an important source of profits and avenue for achieving excellent commercial performance. These services can be used by manufacturers to differentiate themselves from the competition and add value to their products.

Customer-perceived FSQ is the manner by which a customer perceives the quality of a product or service, whereas absolute or actual TSQ is the viewpoint adopted by a product manufacturer or firm in accordance with standard specifications.

The importance of quality, whether in a tangible product or service, is essential to sustaining a business. Quality differentiation can endow a company an advantage over its competitors. Quality is synonymous with the absence of defects (zero defects). The price of a product or service reflects the price of quality costs.

Customers are categorized according to the value that they contribute to the business of a firm. They are referred to as value drivers if they contribute positively to a company's business and are referred to as value destroyers if they contribute negatively (Figure 2).

A critical responsibility for MT manufactures is to incorporate customer voice in the design of new products. With such an approach, a customer feels that he/she is part of the product design process and therefore becomes satisfied with the company and its offerings.

In this thesis, an example that features an MT manufacturer and an ASV AS service provider has been discussed. An essential requirement for MT manufacturers is to provide all the necessary support for ASVs to effectively satisfy customers through the provision of personalized services that cannot be easily copied by competitors. An MT manufacturer provides training on products, warranty policies, spare parts for repair, problem resolution and escalation (from ASVs), and software and hardware to ASVs. An ASV serves end-customers and provides feedback to MT manufacturers, which in turn, use the information in developing upcoming products. The ASV should train other technicians in different ASV divisions to ensure competence in each department.

### **3. VALUE OF COMPLAINTS**

On the basis of the literature, this chapter examines how customer complaints should be handled in the after-sales phase. It explores the improvement process for handling customer problems and discusses two examples of customer problem resolution. The importance of prioritizing customer-reported problems is also elaborated. Finally, the skills (hard and soft competencies) required to effectively address customer problems are presented.

#### **3.1 Handling Customer Complaints**

Complaints about malfunctioning products or poor services are a constant. As mobile phone technology rapidly evolves, so do associated technological problems. Considerable research (books and articles) has been devoted to the definition of “complaint,” but the most prominent come from books on complaint management [e.g., “Heart of customer relationship management” by Strauss & Seidel (2004) and “A complaint is a gift” by Barlow & Moller (2008)]. Barlow et al. (2008) define complaints as statements about expectations that have not been satisfied regardless of whether the complaints are related to tangible products or intangible services. Complaints can be raised by customers or members of interest groups, such as institutions or media, which, for example, complain about damage caused to the environment because of an ecologically harmful production process. Strauss and Seidel (2004) identify five major prejudices that are normally encountered in service provision to customers. The pre-assumptions are summarized in Table 2.

**Table 2.** True and false statements regarding complaints (source: Strauss & Seidel, 2004, pp. 18–19)

No	Preconception	Comment
1	“Our customers are satisfied. The low number of incoming complaints proves it.”	“Wrong! Low complaint numbers are not a meaningful indicator of customer satisfaction!”
2	“The number of complaints should be minimized.”	“Wrong! The number of unsatisfied customers should be minimized. The percentage of dissatisfied customers who complain should be maximized!”
3	“Customers who complain are adversaries!”	“Wrong! Customers who complain are partners!”
4	“The majority of customers who complain are either grumblers or grouchers!”	“Wrong! The vast majority of customers are not grumblers or grouchers!”
5	“Complaints only lead to greater costs!”	“Wrong! Complaints are not associated solely with costs, but instead provide opportunities for higher revenue and profits. Ignoring complaints, on the other hand, only leads to greater costs, never to higher revenue!”

Complaints are powerful tools that can be used by managers or leaders to improve the overall performance of an organization or institution (e.g., Chandra, 2009; Paraschivescu, 2012). A wide range of literature emphasizes the importance of complaints, including the explanation of the concept of a golden complaint (Harari, 1999) and complaint opportunities (Boden, 2001). Leaders should thoroughly investigate the feedback that they obtain from the field to prevent missing opportunities for prosperous business (Pfeffer, 2007). Feedback from the field affords product manufacturers or service providers the opportunity to improve current operations and enhance product and service quality (Harari, 1999).

Resnik (1983) states that “although complaints also serve as customer feedback about a product, service or company performance, their impact on corporate policy and public relations may range from negligible to extremely significant.”

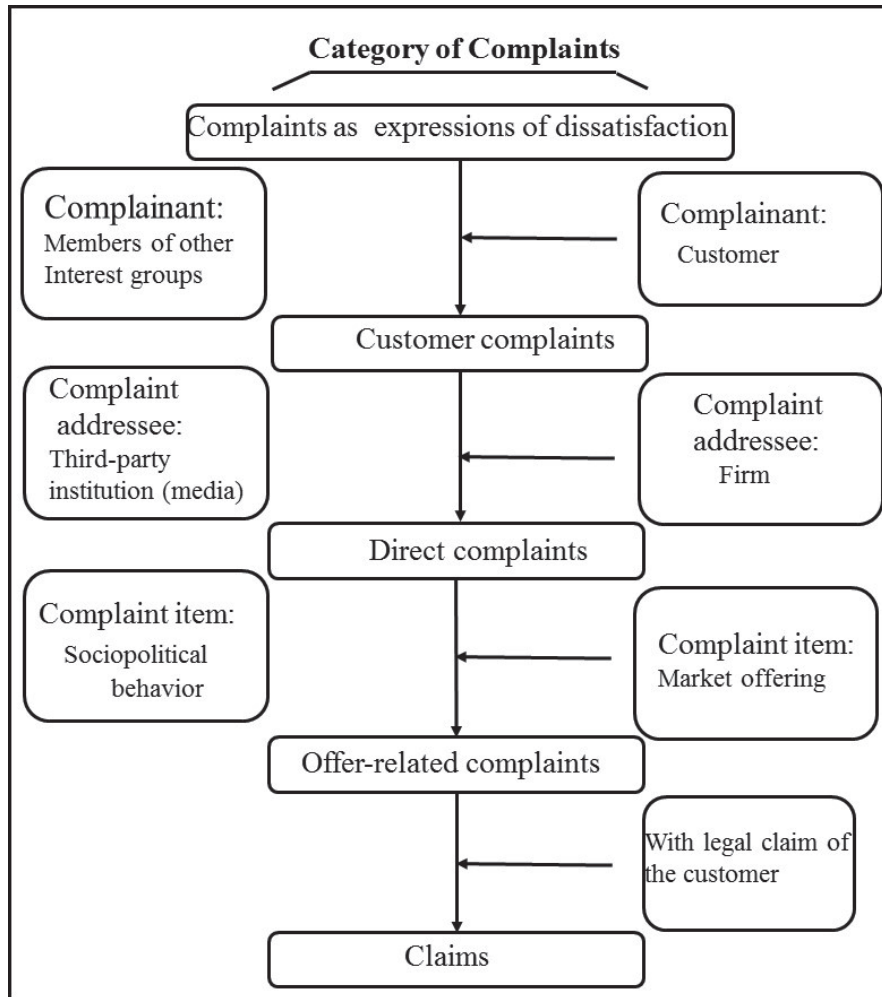
### 3.2 Complaint Management

Fornell and Wernerfelt (1988) define complaint management by contrasting it with warranties and guarantees. A warranty is a limited provision, which stipulates that a product, if covered, will be brought to working order at the expense of the seller. Warranty policies differ from country to country. In the European Union (EU), the warranty period for mobile phones is two years (Greenwood, 2011). Within this time frame, if a defect is detected in an MT, the manufacturer bears the expenses incurred from repairs and other costs covered by the warranty. European Directive 1999/44/EC states that all EU countries should ensure that a retailer is held liable for all “non-conformities” that manifest within two years from delivery (Brignall, 2011). The second important element of complaint management is the facilitation of the voicing of complaints. Third, because warranties and service contracts may be restricted to a subset of a firm’s buyers, complaint management normally applies to all customers. The fourth element is that complaint management is often tied to efforts related to quality improvement.

Gilly et al. (1991, pp. 299–300) state the following:

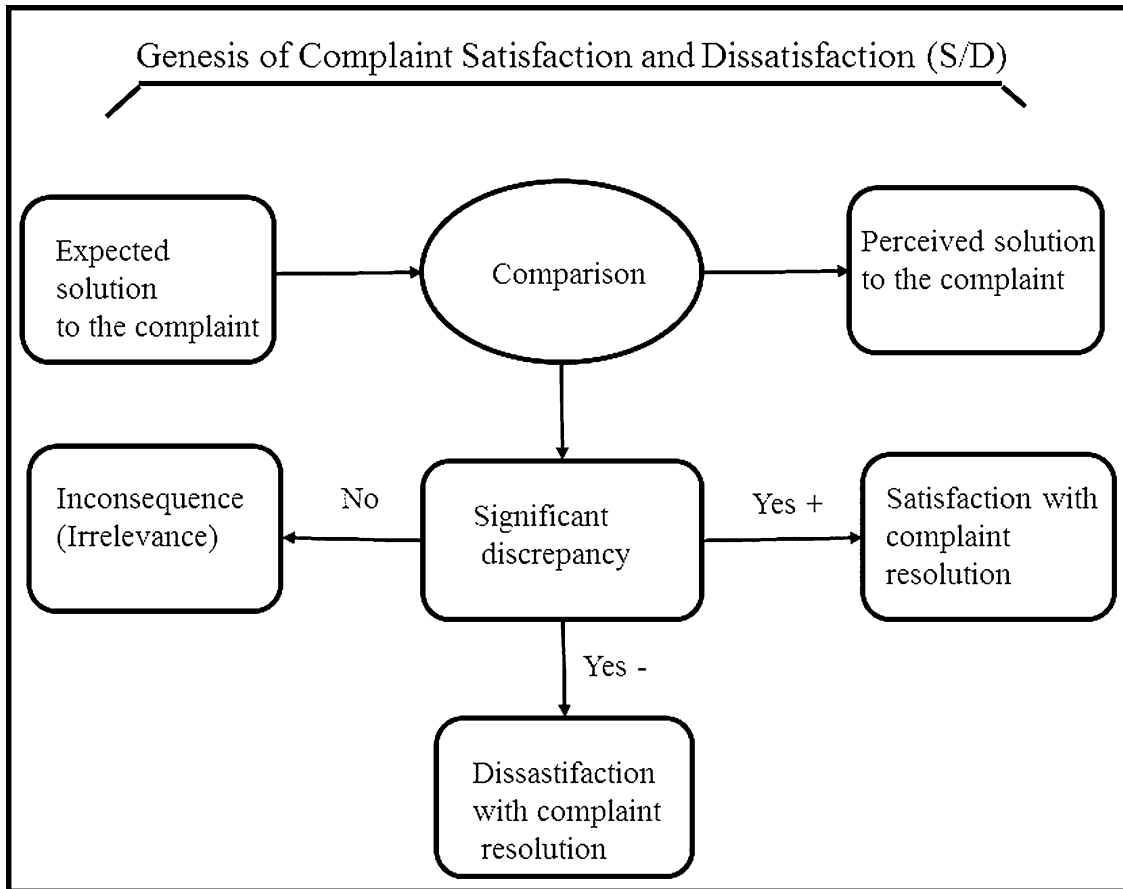
“Complaint management can be viewed as a problem of information process within the organization. Information processing models of organizational communication and decision making process from three basic assumptions: 1) the task of the organization present uncertainties 2) these uncertainties can be reduced by increasing the amount of information available and 3) information can be managed by formal design that is by creating formally specified individuals and groups to deal with problems.”

Complaint management is a component of retention management. An important consideration, however, is that customers raise not only complaints, but also other articulations, including primary orders, terminations, notices of amendment, praise, enquiries, and ideas for improvement (Strauss & Seidel, 2004). Complaints can be categorized into different classes (Figure 6).



**Figure 6.** Types of complaints (adapted from Strauss & Seidel. 2004, p. 17).

Sometimes no distinction is made between the terms “complaint” and “claim.” In a strict sense, claims characterize a subset of complaints, in which customers in the after-sales phase directly or indirectly connect complaints about products or services to a lawful demand that can be taken up legally if necessary. Figure 6 shows that complaints are raised not only by customers, but also by members of interest groups or institutions. Customers can choose the indirect path by turning to a third party institution, which in Finland, is known as the Finnish Competition and Consumer Authority; this organization is an advocate of consumer interests (FCA, 2013). In some cases, the social behavior of a firm can be a subject of complaints. The origins of satisfaction and dissatisfaction with complaint resolution are displayed in Figure 7.

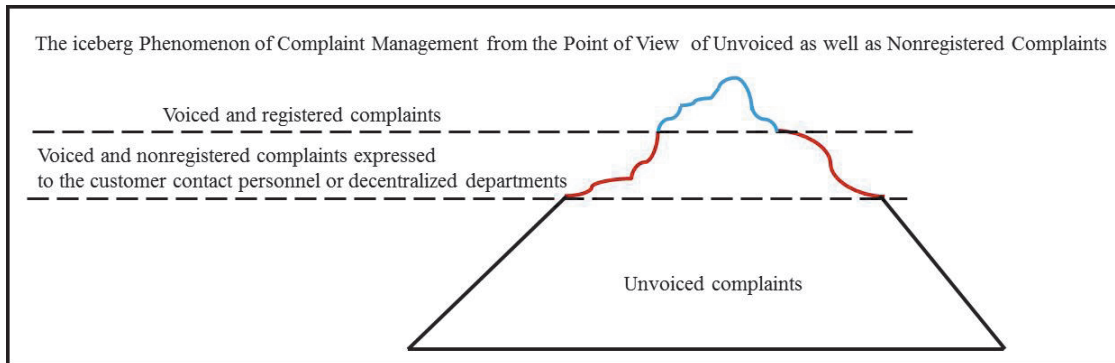


**Figure 7.** Origin of satisfaction and dissatisfaction with complaint resolution (adapted from Strauss & Seidel, 2004, p. 26).

Customers have certain expectations about a firm's response and target solution (Oliver, 1997). Customer expectation is the standard on whose basis customers assess their actual experience with a firm's reaction (perceived response to a complaint). Exceeding a customer's expectation results in satisfaction with complaint resolution. If expectations are simply fulfilled, then the result is indifference. Failure to satisfy expectations causes dissatisfaction with complaint resolution (Figure 7).

Different research studies have revealed that not all dissatisfied customers articulate their complaints. Thus, only a portion of complaints are received by firms, and in this process, a considerably significant variable is the total articulation rate, which is an expression of the ratio of the number of complaints to the number of all dissatisfied customers who have reason to complain (TARP, 1979, p. 197). Firms can achieve good business performance by increasing the rate of customers who log their complaints, from which companies can learn insights into

improving the quality of products or services (Rad, 2011). Voiced and unvoiced complaints constitute an occurrence called the iceberg phenomenon (Figure 8).



**Figure 8.** Voiced and unvoiced complaints (iceberg phenomenon) (adapted from Strauss & Seidel, 2004, p. 140).

As shown in Figure 8, the part of the iceberg that is visible shrinks considerably when hidden complaints are taken into account. Only 10% to 60% of customer complaints are escalated to a core department for handling complaints. The difference between registered and nonregistered complaints is used to calculate the registered articulation rate (RAR), in addition to the total articulation rate, by relating the number of complaints actually registered to the absolute number of dissatisfied customers. The quotient is normally much lower than that for the total articulation rate. The share of hidden complaints on a company is then reflected in the difference between two articulation rates (Strauss, 2004 p. 141)

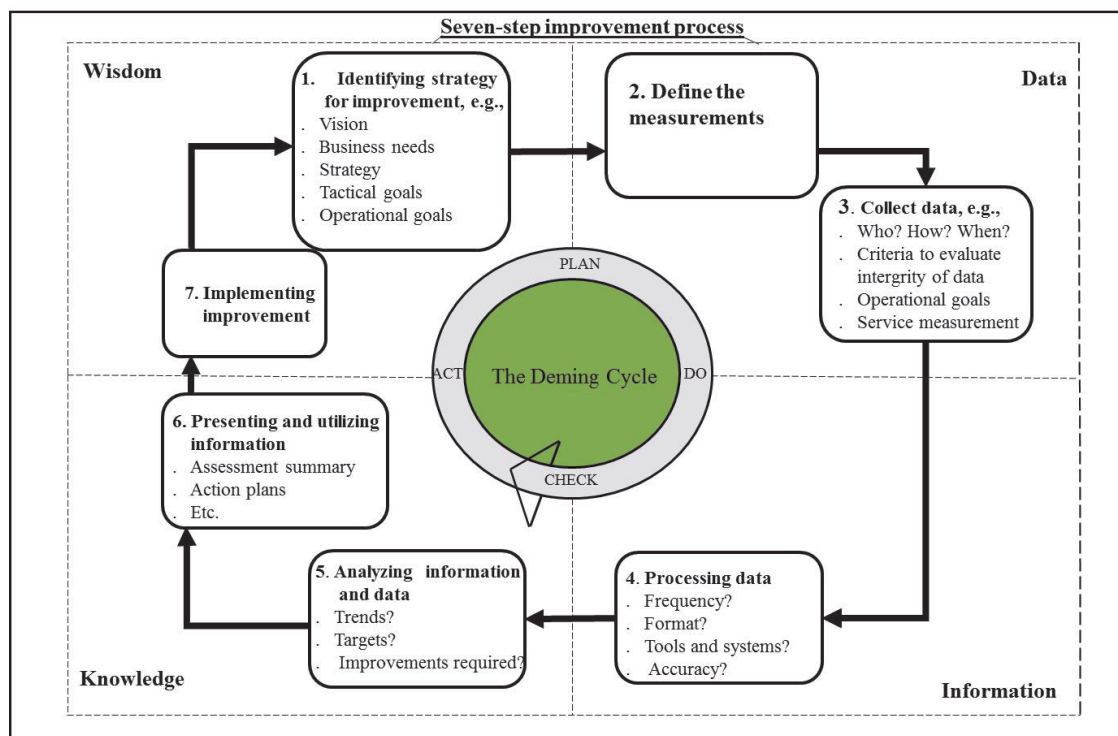
### 3.2.1 Seven-Step Improvement Process

Tieturi ITIL (2014) identifies a seven-step improvement process for handling customer complaints. The steps combine three different processes (Figure 9): (1) data, information, knowledge, and wisdom (DIKW) (Zeleny, 1987; Ackoff, 1989), (2) the Deming quality cycle (plan, do, check, and act), and (3) the aforementioned seven steps. According to Tieturi (2014),

“The DIKW is a knowledge management which has a purpose of sharing perspectives, ideas and information to ensure that these elements are available in the right place and the right time to enable informed decisions; and improve efficiency by reducing the need to discover knowledge.”

The Deming cycle is a guide for continuous quality control.





**Figure 9.** Seven steps for improving the process of handling customer complaints (adapted from Tieturi, 2014).

DIKW and the Deming quality control are embedded in the seven steps for improving the process of customer complaint handling. The strategy for improvement is identified, and its measurement is defined. Data are gathered and processed to derive information for measurement purposes. The information and data are checked and analyzed to draw knowledge. The lessons learned for improvement are then acted upon and implemented.

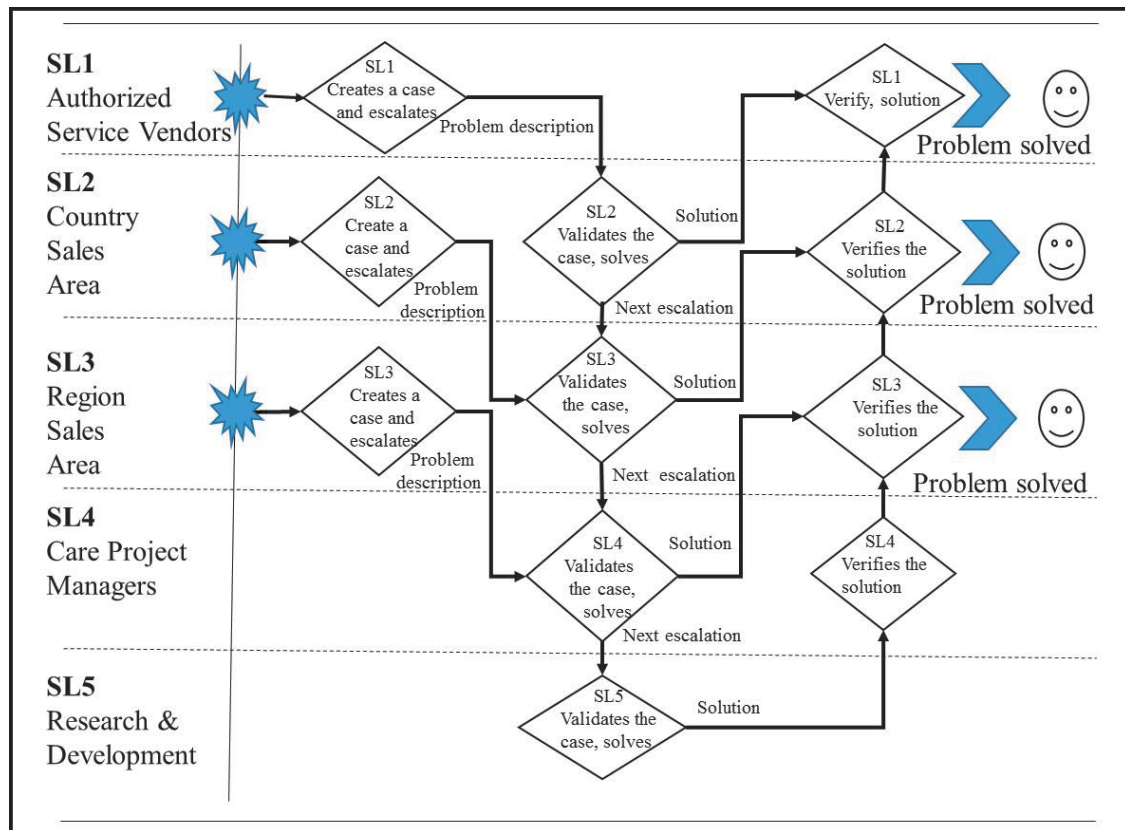
### 3.3 Examples of Complaint Handling

In this sub-chapter, two examples of how complaints are handled are illustrated. The first example is a concrete situation in a firm that manufactures MTs. The second example is a generic illustration taken from the literature.

#### 3.3.1 Handling Complaints regarding Mobile Terminals

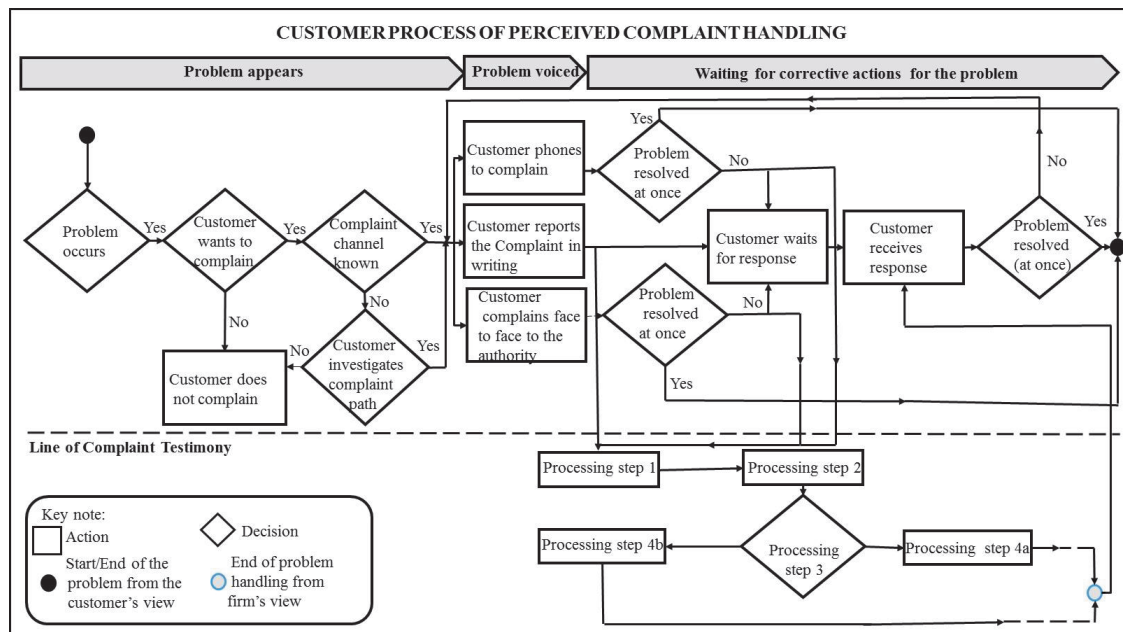
The succeeding example demonstrates how customer complaints regarding MTs can be handled. The process involves five different levels, each having its own specific role and targets. As shown in Figure 10, service level 1 (SL1) refers to the ASV level, which operates externally to a

manufacturing company. It is the front-end level and entertains MT end-users with complaints. If SL1 cannot solve a given problem, it escalates this problem to the next level, i.e., SL2. SL2 is a level that involves participation from a manufacturing company located in a country where SL1 is located. Once SL2 resolves the problem, it relays the issue back to SL1 for verification and closes the reported case. If SL2 is unable to solve the problem, then it elevates the case to SL3, which is usually based in a region defined by the company. Once SL3 resolves the problem, it re-directs the issue to SL2, which then verifies the solution to the problem if the case solution is to be relayed to SL1, which then contacts the end-user. The procedure for problem resolution is continuous as long as a solution is found by one of the SLs. For the chain to work effectively, the staff working at the different levels must have regular training on new products (Mwegerano et al, 2014 b).



**Figure 10.** Handling customer complaints in MT (adapted from the case company).

### 3.3.2 Generic Example of Problem Handling



**Figure 11.** Customer process of perceived complaint handling (adapted from Strauss & Seidel, 2004, p. 80).

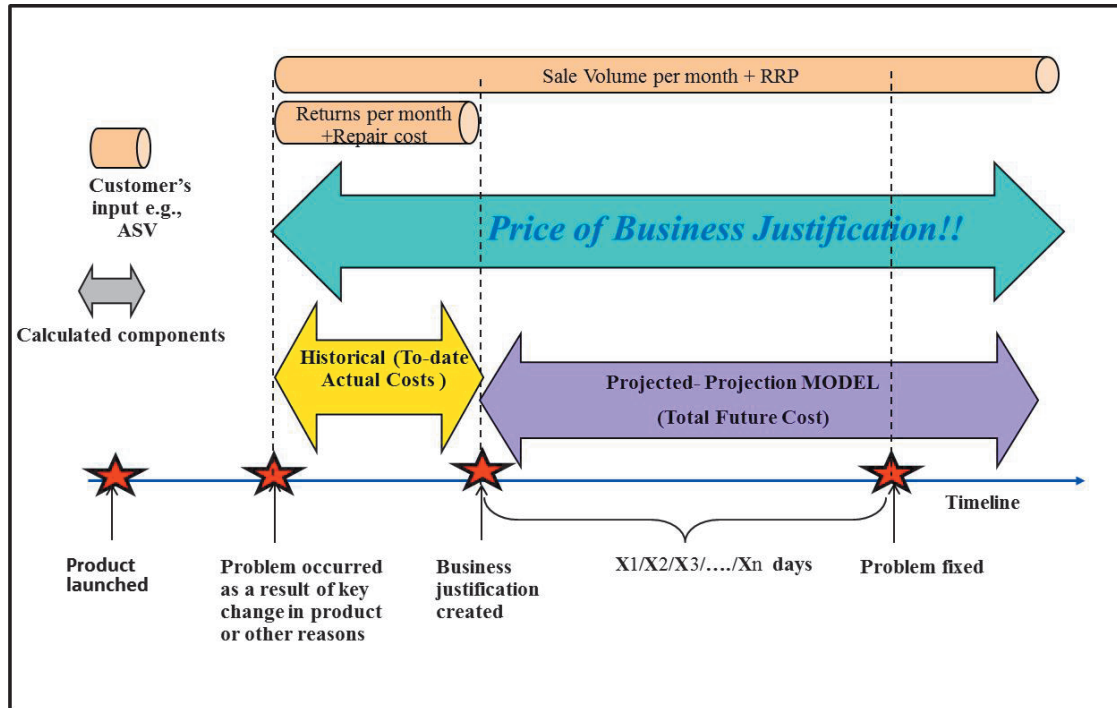
Figure 11 shows three main components of complaint handling: the time at which a customer experiences a problem, the time at which a customer voices his/her complaint to the concerned authority, and the waiting period for corrective action. Studies confirm that the speed with which firms react to a complaint significantly influences CS (Adamson, 1993; Clark et al, 1992). The flow chart in Figure 11 is self-explanatory; thus, this process does not need to be discussed in detail.

### 3.3.3 Prioritizing Customer Complaints

Given the high volume of complaints that a firm can receive, criteria on how complaints should be prioritized should be developed because not every single complaint will be investigated or acted upon (Strauss & Seidel, 2004; Ozsayin, 2002). The criteria will help companies manage available resources and focus on certain complaints, thus increasing efficiency and accountability during complaint handling. For consistency in decisions and outcomes, the same criteria should be applied to every complaint.

As an example specific to mobile telephones, when a complaint is raised to troubleshooters, the effects of the complaint on business performance should be identified. These effects indicate how much a company loses in terms of finances before a complaint is escalated to troubleshooters.

Moreover, a business impact model should forecast future financial situations should a company fail to address a complaint within a certain timeframe. Figure 12 illustrates what a complaint model should generate to determine the business effect of a quality complaint reported by a customer.



**Figure 12.** Illustration of price tagging of quality complaint (Mwegerano et al, 2008).

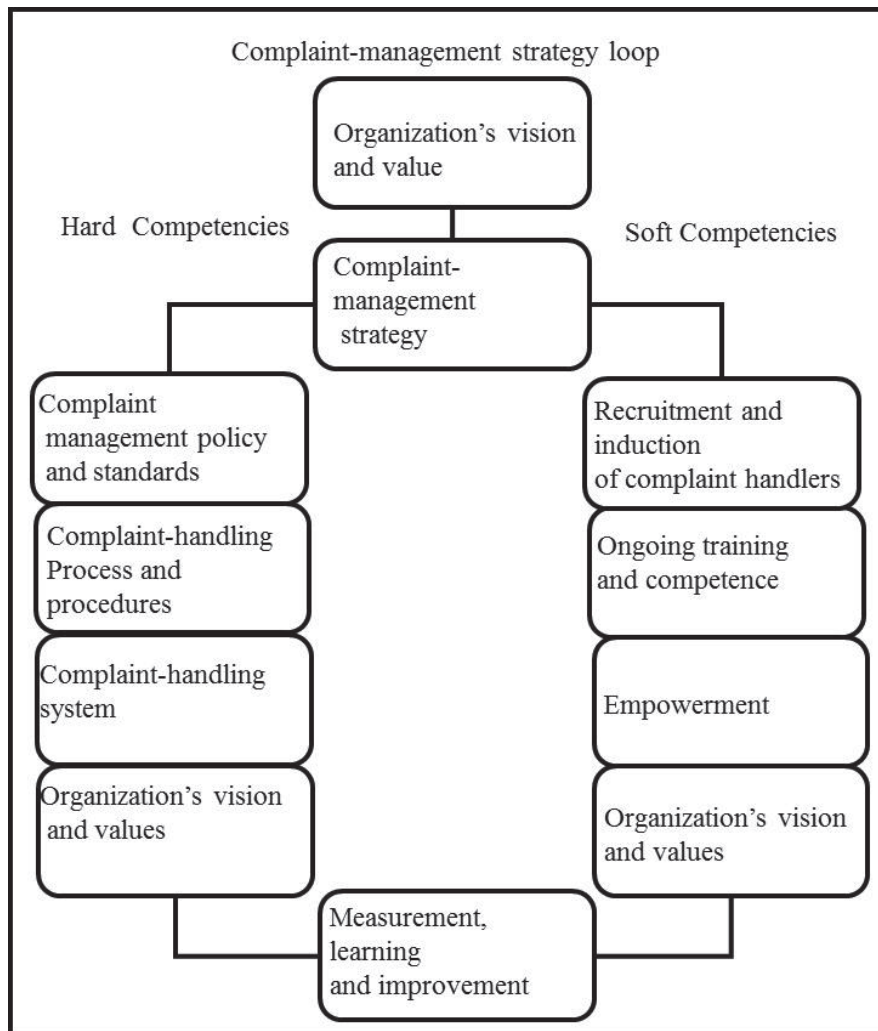
As depicted in Figure 12, the historical component of loss incurred stems from the interval between customer experience of a problem and the reporting of a complaint. Historical repair data are used to estimate the average field failure rate (FFR) to project future warranty costs with a projection model. The projected-projection model enables the calculation of total future cost as long as customer-raised problems are solved. With the estimated cost losses caused by a problem, troubleshooters can prioritize resources and time, thereby allowing them to focus on the problems presented by customers.

### 3.4 Hard and Soft Elements of a Complaint Management Strategy

Best-practice complaint management strategies are aligned with organizational goals and values. Organizational value differs by company, but such a value commonly encompasses company

heritage across all organizations. Organizations have a clear vision, set values that focus on customers, and link complaint handling strategies to these values.

Figure 13 demonstrates how a complaint management strategy should serve as an umbrella approach that covers both hard and soft competencies in complaint management. The figure also reveals how measurement, learning, and improvement that complete the feedback loop can be aligned to realize excellent complaint management (Cook, 2012). A customer complaint policy should be transparent, i.e., it should clearly instruct customers on where to direct or log their complaints and should provide information on expected resolution time. A critical requirement is for policy to be understood by employees, who should also be trained on such a policy on an annual basis.



**Figure 13.** Complaint management strategy (adapted from Cook, 2012).

Internally, a complaint policy should cover the methods, roles, and responsibilities that fall under different functions or activities. Policy standards are reviewed on a regular basis to ensure that they are implemented and remain relevant.

In the complaint-handling process, a complaint management policy clarifies the procedures used to handle complaints. This clarification requires training of employees concerning relevant steps and their roles and responsibilities.

In a complaint-handling system, a single management structure for addressing complaints from beginning to resolution is recommended. This structure enables organizations to quickly identify how complaints are being dealt with, and rewards can be provided to staff for excellent service and behavior. Complaints are rapidly identified and given priority accordingly, after which key improvements (e.g., training, etc.) can be implemented.

In terms of manpower, employees who handle complaints should competently recognize and effectively address problems. In terms of recruitment, hiring the right complaint handlers is key to delivering excellent service. The right people can reduce attrition rates. The induction of new employees to complaint management processes is also important because it helps shape people's attitudes toward businesses and customers.

Training and competence are critical for complaint handlers to effectively reassure customers, address complaints in a rapid and just manner, derive fair outcomes, and prevent problem recurrence. To ensure that employees competently deal with complaints, a useful strategy is to develop a complaint-handling competency framework. This framework can establish the level of business knowledge required of troubleshooters, as well the skills and behaviors associated with each role. Complaint handlers can chart a solid career path and talent and can be developed.

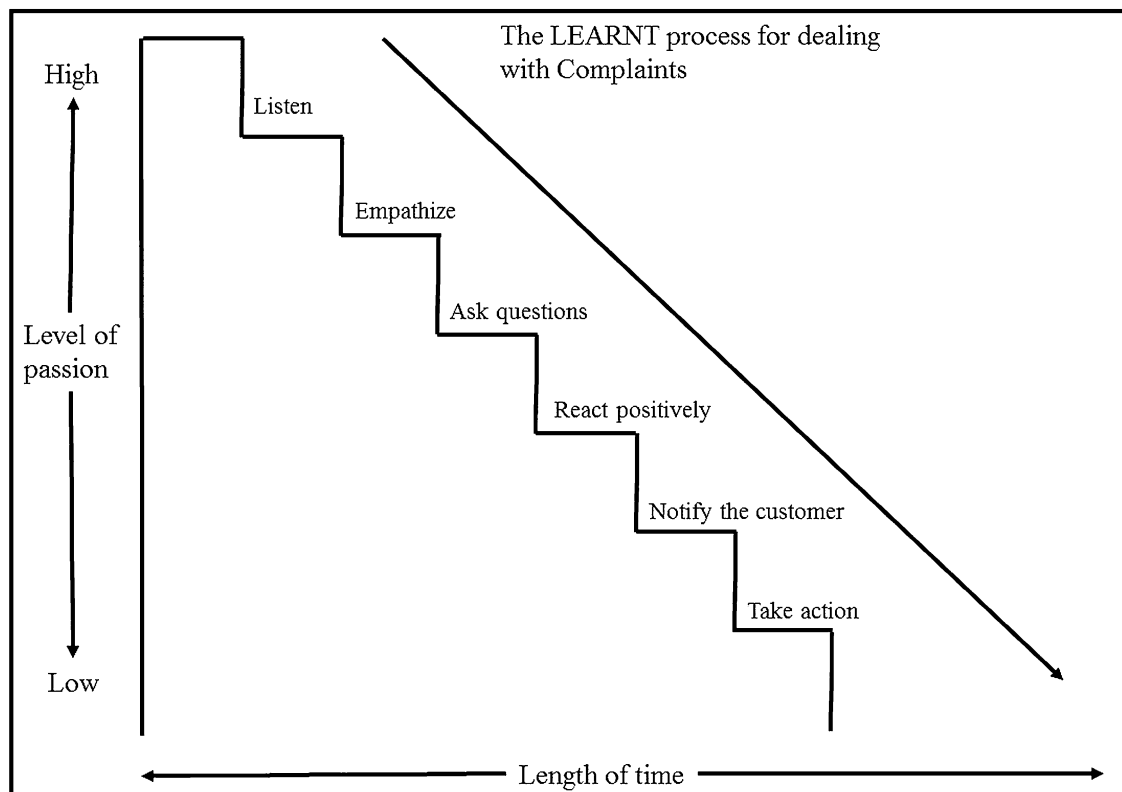
Empowerment endows complaint handlers with the authority to decide on the manner by which a customer's problems can be independently resolved (i.e., without consultation with or elevation to higher authorities). According to Cook (2012), loss of autonomy and low motivation and depression are directly linked. Customer researchers demonstrate that consumers prefer their complaints to be addressed by people who can immediately decide on a given situation.

Measurement of complaint handling is also carefully planned and executed. Measuring the wrong performance factors can ruin a business. For example, measuring the time it takes to solve a customer's problem can generate the wrong outcomes given that some complaint handlers report problems that can be resolved in a short period while intentionally disregarding difficult cases that take longer to resolve. Such handlers adopt this strategy so as not to miss out on their bonus targets, which are based on the measurement. A quality measure should assess appropriate

behavior, and the goals of management and quality assurance teams should be fully aligned with customer management strategies.

Learning and improvement for hard and soft competencies in complaint management are continuous processes that are driven by complaints.

### 3.5 LEARNT Process for Dealing with Complaints



**Figure 14.** Skills and behaviors needed for dealing effectively with complaints (adapted from Cook, 2012, p. 92).

Figure 14 displays some of the important characteristic behaviors that a complaint handler should have. The six-step process illustrated is aimed at facilitating the handling of customer complaints in an assertive but empathetic manner.

Comprehensively investigating a problem presented by a customer necessitates deep listening. Complaint recording characterized by a judgmental attitude does not contribute to problem resolution. Effective listening pertains to being focused or actively paying attention to what a customer is saying. Going beyond being active and focused listening means becoming an intuitive

listener. Intuitive listening centers on using one's emotional intelligence to tune into a customer's situation and understand what he/she is feeling and what he/she is not saying.

In dealing with customer complaints, the first step is offering a sincere apology, followed by a show of empathy, which means identifying with and acknowledging customers' feelings and emotions.

Open questions are preferred to closed question because the former provides opportunities for customers to express themselves in detail (Cook, 2004, p. 89). Open questions start with such phrases as "please describe" or "explain the situation" as opposed to closed questions, which are mainly how, why, when, or who questions. Closed questions receive short responses, such as "yes" or "no." Leading questions should also be avoided for the same reason as that for closed questions. Positive expressions should be used even when conveying bad news to a customer.

Once agreement with a customer is reached on how to deal with a problem, the customer must be kept notified of the progress with which a problem is being resolved. Other essential components of CS are keeping promises to customers and implementing pledged action.

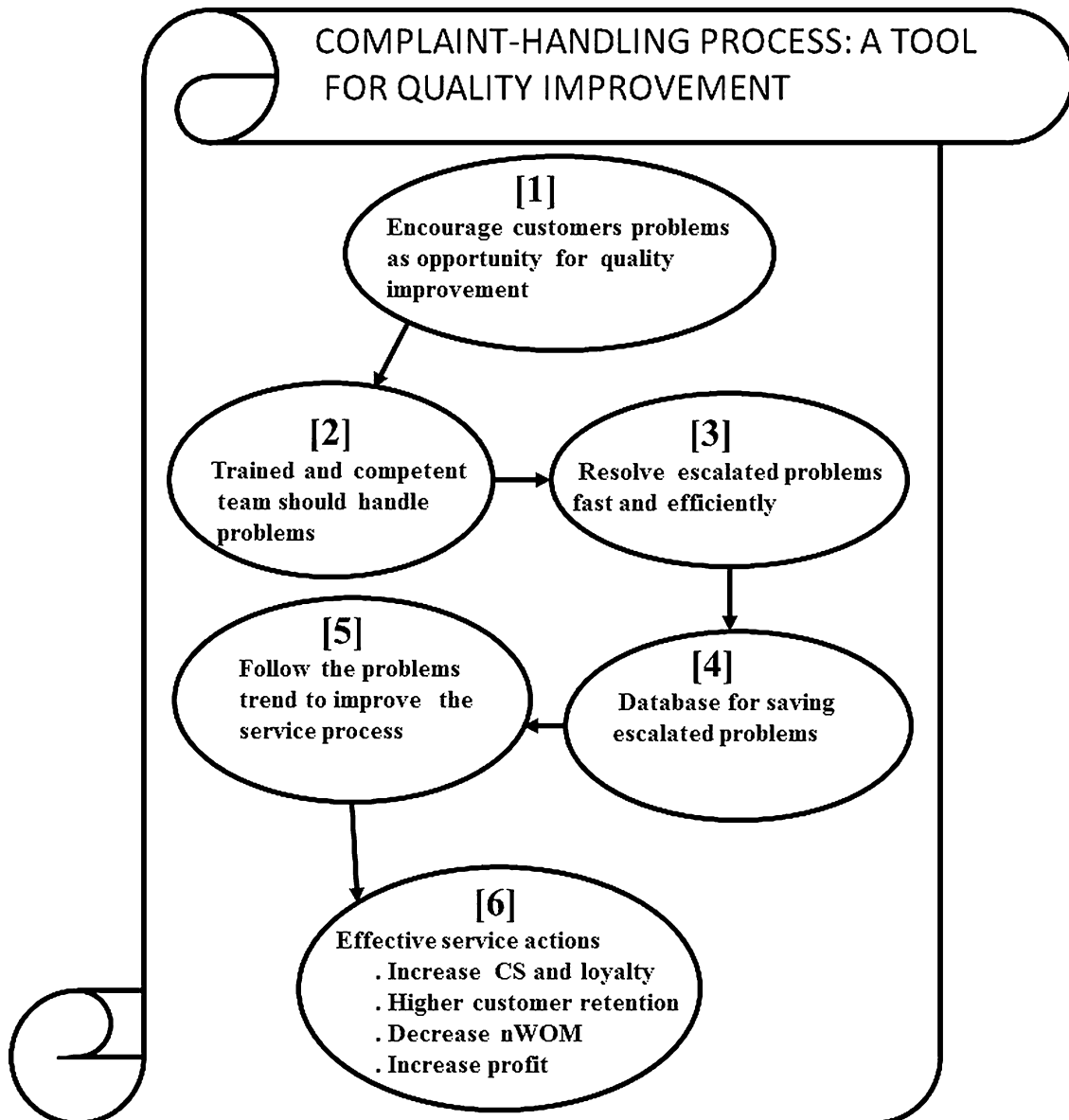
### **3.6 Summary**

Complaints are important and powerful opportunities that can be maximized by managers or leaders to improve the overall performance of an organization or institution. Complaints also serve as customer feedback about a product, service, or company performance, and their effects on corporate policy and public relations may range from negligible to extremely significant (Resnik, 1983).

Customers hold certain expectations for a firm's responses and target solutions (Oliver, 1997). Customer expectation is the standard on whose basis customers evaluate actual experience with company responses (perceived reactions to complaints). Exceeding customer expectations results in satisfaction with complaint resolution; the opposite causes dissatisfaction. Complaint management is a component of retention management, but an important consideration is that customers not only raise complaints, but also articulate other needs, including primary orders, terminations, notices of amendment, praise, enquiries, and ideas for improvement (Strauss & Seidel, 2004).

Because the volume of customer complaints can be high, a strategy for prioritizing complaints should be developed. Not every single complaint will be investigated or acted on (Strauss & Seidel, 2004; Ozsayin, 2002).





**Figure 15.** Complaint-handling process for quality improvement (adapted from Bendall-Lyon & Powers, 2001).

As displayed in Figure 15, handling customer-escalated problems can be regarded as an opportunity for quality improvement, especially during the following situations:

1. Customers are encouraged to openly raise their concerns and are provided avenues in which they can exert low effort. The iceberg phenomenon should be minimized by encouraging customers to voice out their concerns via (for example) social media, Internet-based platforms, and the like (Bendall-Lyon & Powers, 2001; Johnston & Mehra, 2002; Soheil, 2011).

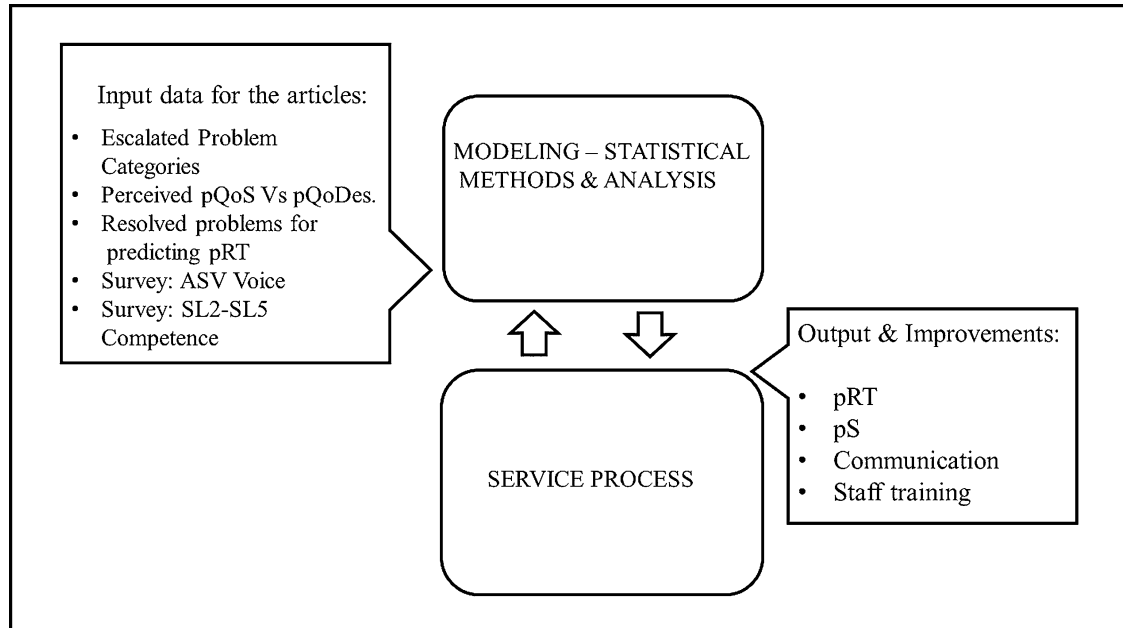
2. Customer's problems are handled by trained and competent employees from the front-end to internal departments (e.g., Prahalad & Hamel, 1990; Henkoff, 1994; Stasz, 1997; Burke et al, 2005; Mwegerano, 2014b).
3. Problems are rapidly and effectively resolved to minimize the time and financial losses that may occur because of lengthy problem resolution. Problem escalation from one department to another should be minimized because this contributes to prolonged resolution time, which in turn, leads to customer dissatisfaction. Problems should be resolved from the instance at which they are reported. Front-end staff should be equipped and empowered to resolve problems the first time these are raised by a customer (Salanova & Peiro, 2005).
4. An in-house database tool should be in place for documenting the problems raised by customers. Such a tool facilitates retrieval and analysis.
5. The data accumulated in a database are used for analysis that is aimed at identifying root causes and corrective actions. Analysis results are used for preventive actions that are designed to avoid the recurrence of problems in products that are developed and manufactured in the future (e.g., Tax & Brown, 1998).
6. Lessons are learned from previous problems, and appropriate methods are established to analyze methods of cross sectional and longitudinal problem observation.

As previously discussed, a single-management complaint-handling system that addresses complaints, from reporting to resolution, is favorable because it enables organizations to quickly identify strategies for complaint resolution. Employees can be rewarded for excellent service and behavior. Under such a system, complaints are rapidly identified and given priority accordingly. This process can then be succeeded by key improvements, such as training. Training and competence are critical for complaint handlers to effectively reassure customers deal with complaints in a fast and fair manner, derive equitable outcomes, and prevent problem recurrence (e.g., Zairi, 2000; Vons & Huitema, 2008).

The manner by which customer complaints are handled by a company influences CS with a service or product. CS can be measured through interaction with consumers, during which employees ask customers about their perceptions regarding provided services (Plymire, 1991). Longitudinal surveys are other avenues from which to measure CS (Plymire, 1991; Mwegerano et al, 2007; Mwegerano & Sippola, 2014a). Effective customer problem handling also increases loyalty, and therefore, retention. Furthermore, such effectiveness reduces nWOM, thereby earning a company increases in revenue.

## 4. SUMMARY OF THE PUBLICATIONS

This chapter discusses and summarizes the articles reviewed in this thesis (Table 3). The articles employ different statistical analysis methods, depending on type of data. Figure 16 illustrates a conceptual mode used in the articles and the goals of the published materials.



**Figure 16.** Conceptual model for the articles used in the thesis.

For publication 1, the input data on escalated problems were collected from in-house data on three different product categories. The aims were to analyze the root cause of the reported problems and to optimize pRT [or issue resolution time (iRT) in the article] for these problems. Publication 2 used a combination of survey data and data from an in-house database. The research purpose was to investigate the relationship between the perceived quality of problem description presented by customers (i.e., ASV SL1) and the perceived quality of pS (CA) presented by the problem resolvers (mainly SL2–SL4) (see Figures 10 and 17 for SL definitions). The results of publication II can be regarded as reflective of the communication or interaction between problem presenters and problem resolvers. The aim of publication 3 was to determine whether pRT (iRT) can be predicted from the first instance that it is escalated for solution. Knowing the pRT would benefit customers and developers that invest resources and time in designing and manufacturing products. Publication 4 used a questionnaire survey to capture the perceptions of ASVs with respect to a manufacturing company. This study aimed to investigate communication between an ASV and the manufacturing company and identify opportunities for improvement to enable both parties to create a win-win situation. Publication

5 investigated the challenges and competencies in SL2 to SL4 given that these divisions are the main troubleshooters of the problems raised by ASVs. Conducting product training and refining employee competence in handling the problems raised by customers (i.e., ASVs) save time and revenue for the product manufacturer because effective complaint handling and resolution satisfies customers and inspires loyalty and long-term retention. More detailed information about the articles is presented in the succeeding sections.

#### 4.1 Summary of the Publications and Statistical Methods Employed

Table 3 summarizes the data types and statistical methods applied in the articles. The publication details are explained under the publication section.

**Table 3.** Structure of the articles

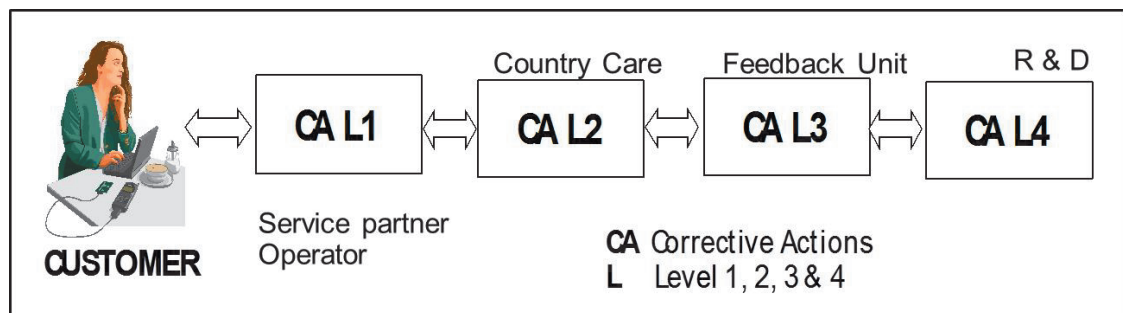
Publication	Year	Data Type	Analysis Methods Applied
1	2008	Empirical	Weibull Distribution, simple correspondence and principal component analysis
2	2007	Empirical + Survey	Linear regression, multiple correspondence and principal component analyses
3	2013	Empirical	Linear model and analysis of variances
4	2014	Survey	Descriptive statistics
5	2014	Survey	Item analysis, ordinal logistic regression, Cronbach's alpha and mood's mean test

The articles were published between 2008 and 2014. The empirical data for publications 1, 2 (part of the data), and 3 were collected from an in-house-built tool called GENIUS, which is designed for collecting information on and solving problems reported from the field. Articles 4, 5, and 2 (part of the data) were built upon data collected from surveys. The survey data were organized and collected from service staff working in the SC. The questionnaires were sent by e-mail or a web survey was created. The analysis methods for the articles were chosen according to the data type and nature of measurement scale. The contents of the articles are summarized as follows.

#### 4.2 Publication 1

In the first article, corrective actions (CAs) for the different problems encountered in the three different product categories were analyzed. Products 1, 2, and 3 were chosen according to the complexity of their functionalities and features. Product 1 belongs to a basic category, i.e., the

least complicated products in terms of features and functionalities. Products 2 and 3 have more complex features and functions than product 1. In all the three products, a type-A root cause predominates. The activities of different corrective levels in the chain model, Fig. 17, were analyzed, and most of the actions were implemented at levels 2 (L2) and 4 (L4). In this paper, the best distribution model was selected by the Anderson–Darling maximum likelihood method (Mwegerano et al, 2008). The Newton–Raphson algorithm was used to calculate the maximum likelihood estimates of the parameters, which define the distribution. The Weibull distribution was selected because it exhibits the lowest Anderson-Darling value in the goodness-of-fit test. A Pareto chart was applied in the CA analysis to prioritize opportunities. CA “A” exerts a major effect on the three products. Furthermore, a simple correspondence analysis was performed to determine how strongly the CA is associated with different products. The plot tool was used to show the differences in characteristics of the dataset. Principal component analysis (PCA) was also carried out to simplify the dataset by reducing the multi-dimensional data to those of lower dimension for analysis. The CAs at L2 and L4 are the major contributors to the total iRT; thus, the optimization focused on L2 and CA “B” and L4 and CAs “A” and “C.” With product 3 (the most complex product), L1 is a significant contributor to CA “A.” A new iRT was simulated with the desired Weibull shape and scale parameters. As an example, L2 and CA “B” were simulated to determine the distribution before and after optimization. The procedure is applicable to the other products and enables the identification of the improvements needed to optimize iRT. We can conclude that the shorter the iRT, the lower the repair costs which includes time and other components. Note that the acronyms iRT and CA used in publication 1 are equivalent to pRT in the current thesis. This article is included in the doctorate dissertation research conducted at Turku University on May 28, 2014.



**Figure 17.** Block diagram of customer problems escalation chain (Mwegerano et al, 2007)

### 4.3 Publication 2

For publication 2, a batch of randomly chosen issues that were already resolved (period covered, 2004 to 2006) were collected from GENIUS and sent to customers to obtain their opinions on two issues: (1) the perceived quality of a solution and (2) the perceived quality of the time spent in solving the problems that the customers raised. Conversely, the corresponding items were sent to the problem resolvers to acquire their views on the perceived quality of the problem description and additional information on top of the description regarding the problem escalated by a customer. The response to the questions were in 3 levels, (see Table 4) i.e. grades level (Q, T and D) for the (P-QopS), (P-QopRT) and (P-QopDes) respectively. Figure 17 illustrates the model in which the survey was conducted.

**Table 4.** Response levels in the survey

<b>P-QopS</b>	<b>P-QopRT</b>	<b>P-QopDes</b>
Q1 = Problem solved completely	T1 = Excellent	D1 = Described the problem completely
Q2 = Problem solved partially	T2 = OK	D2 = Described the problem partially
Q3 = Problem not solved at ALL	T3 = Too slow	D3 = Did not describe the problem at ALL

Table 4 displays the response grade levels for the questions asked from both the resolvers and the problem presenters.

### 4.4 Publication 3

This work developed a model that predicts iRT as soon as an issue is recorded in the corrective action process (CAP) tool of an in-house-built database for MT products. Depending on the iRT of the estimated issue corrective actions (iCAs), an ASV can lend a customer an MT product for use during the period at which the customer's MT is being evaluated/repared. To predict the iRT, a two-year (2010–2011) data bank of 10,000 resolved technical issues was accumulated from the in-house database and analyzed using the linear model statistical method. The variables that were used to predict the model were (1) the entity type of MT, i.e., the business unit (BU); (2) the software platform (SWP), i.e., operating systems Symbian, Linux tablet, Maemo, CDMA, MeeGo, Mango, and Windows; (3) the program center (PC), i.e., the location where the MT was designed; (4) the sales area (SA), i.e., the location where the MT products were sold; (5) the symptoms accompanying the reported technical issue area (iTA); and (6) the business effect of the reported issue (iBI).

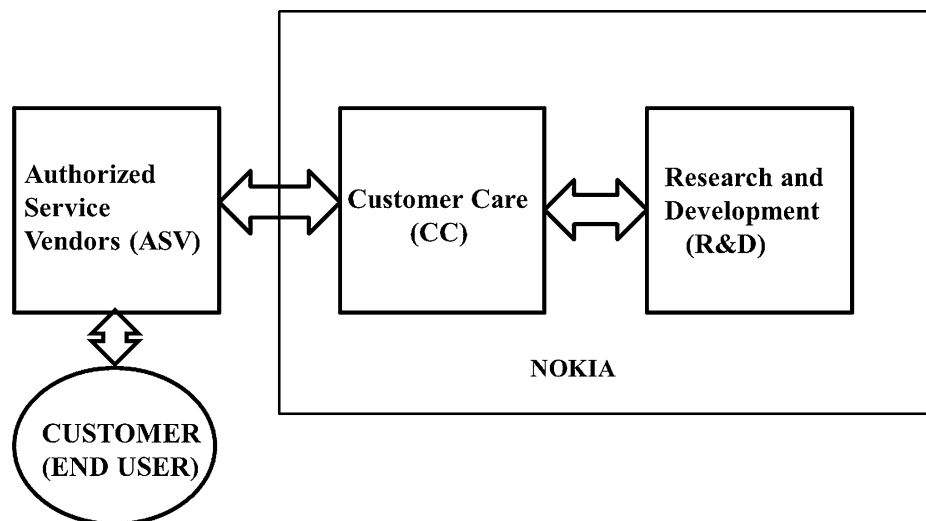
The statistical model used was a linear model. The iRT values were first Box Cox transformed to enable the model to satisfy the assumption of normality. Other model assumptions were also verified. Several candidate variables were proposed for inclusion in the model as explanatory variables, after which the model was reduced by removing a non-significant variable from the SL. The model yields predictions on a Box Cox-transformed scale (the Minitab simply finds an optimal power transformation). Thus, before the model can be built in Excel, coefficients need to be converted into the original scale of measurement. The statistical models for different levels were fitted using Minitab version 16.1. The model was built and tested with Excel. The analysis indicates that the variable predictors selected for building the iRT model explain only 4.4% of the response variations in the model, making this model inapplicable to practical situations. However, the method and methodology applied to research the iRT variables can be used in future when more factors concerning the parameters explaining the variables are found. To improve the model's predictive accuracy, further research should be conducted on other factors and variables that enhance prediction effectiveness. Among other things that should be analyzed is product hardware (e.g., printed wire board) because such components may be of different versions at different stages of a product's lifecycle. Hardware implies a circuit board where all the components that constitute a product are surface mounted or soldered. The same goes for software versions, which includes variant software, which is specific to a given customer, needs to be analyzed. Other factors that may influence iRT are samples for verifying a problem. The time at which samples are received for problem verification is not always predictable because of different customs regulations in different countries; troubleshooters typically wait for a long time before they receive samples (Mwegerano et al, 2012). The iBI is subjective and likely to vary from person to person. A more comprehensive sub-grouping of iTAs would be worth investigating. Other issues that should be explored is determining strategies for how work proceeds in each SL and identifying practices or work operating modes that deviate from assumed standard work routines.

Managers should find ways to build a process that predicts the duration of problem resolution. This work has significant managerial implications, with several latent variables extending beyond the collected traditional resource planning data. The managers can for example explore into the data variables escalated from the field that they are reliable enough or can enhance the details of the escalated problems and from that extract details can be used to build a pRT model.

## 4.5 Publication 4

A seamless relationship between MT manufacturers and ASVs is essential for both parties to prosper in business. Publication 4 examined whether ASVs that carry out repair and other activities are satisfied with MT manufacturers in terms of the services provided to them. It also

explored how ASVs operate. When an ASV provides good services to end-users, CS ratings, loyalty, and retention increase. One way of determining whether the customers (i.e., ASVs) are satisfied with the services that they obtain from MT manufacturers and how ASVs operate is by conducting longitudinal surveys. For this work, a survey questionnaire containing 37 questions was sent to different ASV levels in six different European countries. The study was conducted at Nokia Corporation in Finland and employed an exploratory research design. The association between category variables was descriptively analyzed. The main findings indicate that the studied ASV is satisfied with the MT product manufacturer and that the internal work practices of the ASV are perceived as positive rather than negative. From the standpoint of the MT manufacturer, iRT and training before product launch are items that should be accorded focus in initial stages because these factors affect CS. ASV management should seek a means of sharing end-user customer feedback to ASV teams, and internal information communication should be improved. A simplified block diagram of the relationship between the ASV and the MT manufacturer (Nokia) is shown in Figure 18. The ASV has within itself at least four different competence levels of service. An OEM is normally involved in the highest ASV level given that all customer-raised MT problems are, if not resolved at lower levels, escalated to the highest level in the ASV, which then elevates unresolvable problems to the MT manufacturer.



**Figure 18.** Simplified block diagram of chain network provision and customer issue resolution (Mwegerano et al, 2014c).

#### 4.6 Publication 5

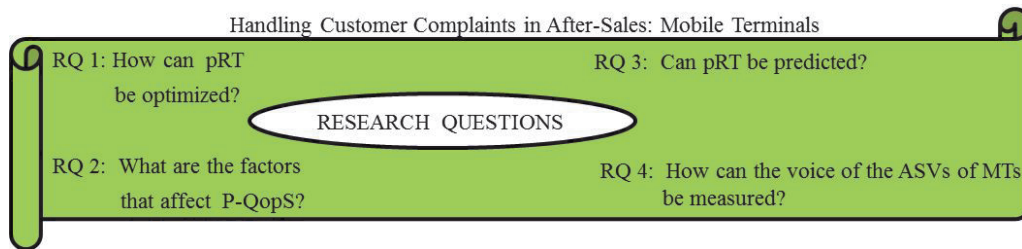
Publication 5 examined the challenges encountered by and the competencies of service staff who resolve the problems that customers experience with their MTs. As noted in the vast amount of literature on the subject, customer service performance is critical to maintaining CS and customer



loyalty (Dixon et al, 2010; Kasper & Lemmink, 1989). The required competencies for service staff in the chain continually change as new products characterized by new technologies evolve. Service personnel are therefore compelled to continually learn new skills that will enable them to exhibit excellent performance in their work. A web-based survey was administered in this study. A total of 15 questions were composed and 75 participants were invited to participate in the survey. The participants were service staff levels 2 to 4. Levels 2, 3, and 4 are company employees and were therefore asked to first examine the internal challenges that they encounter before work involves both internal and external staff. L2, L3, and L4 are the levels that normally carry out CAs for a problem escalated from L1. Given that the data gathered through the survey were categorical, ordinal logistic regression and item analyses were applied. The main findings reveal that the service employees in the chain miss training on new products for launching in the field and that L2, on average, exhibits the best performance among the three levels.

## 5. DISCUSSION AND CONCLUSION

### 5.1 Answers to the Questions

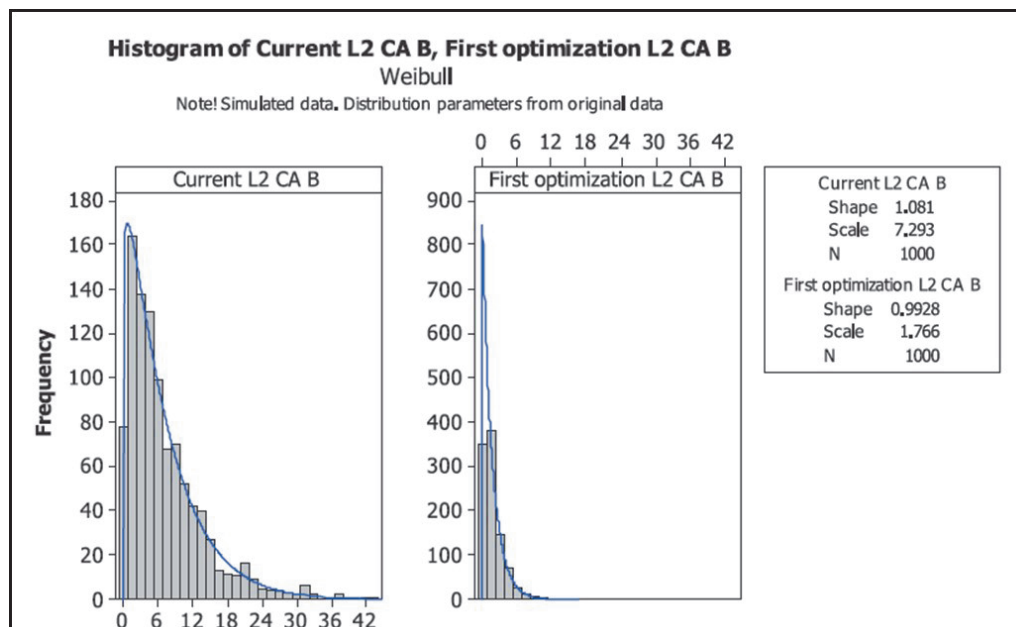


**Figure 19.** Research questions.

This sub-chapter presents the responses to the four formulated RQs as displayed in Fig. 19.

#### RQ 1: How can pRT be optimized?

This question is answered mainly by article 1, which confirms that improving the process by which customer-raised problems are resolved optimizes resolution time (Figure 20). The rest of the articles provide some relevant answers to this question (Table 1).

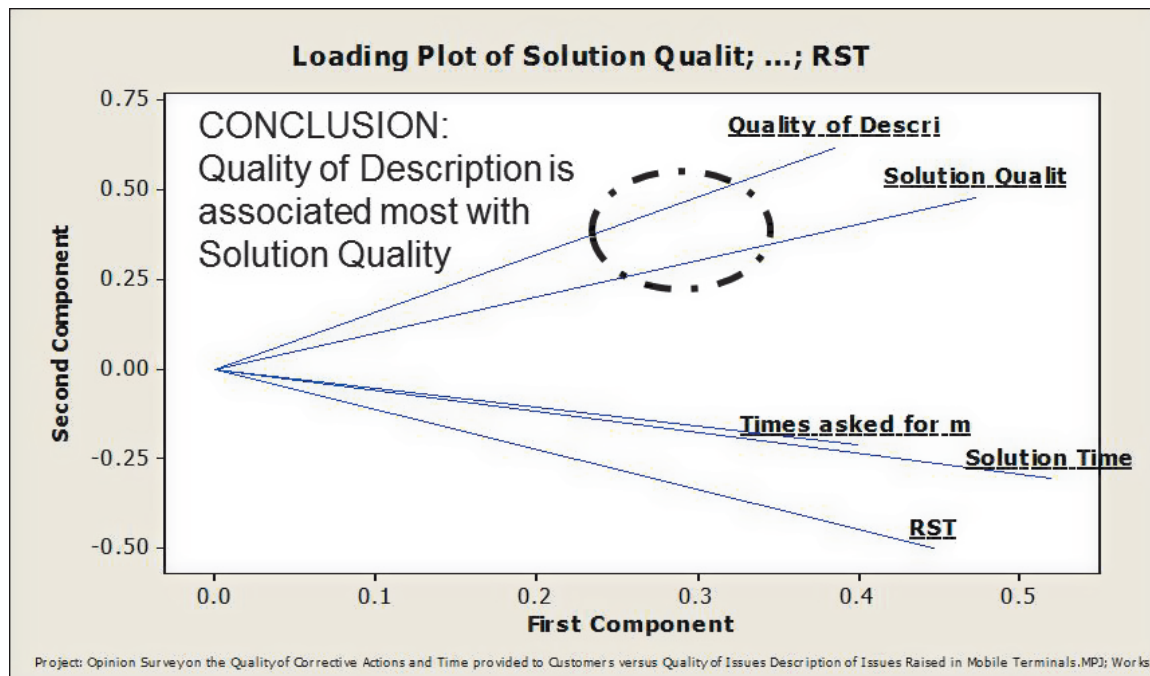


**Figure 20.** Histogrammatic comparison before and after optimization at L2 and corrective actions B.

The CAs (pS) provided for customers and the activities under different corrective levels in the chain model were analyzed in article 1. Most of the actions were carried out at L2 and L4 (refer to Figure 15 for level definitions), and these levels are the major contributors to the total pRT. Hence, optimization was directed toward L2 and L4 in accordance with the CA categories that were evaluated as contributory to a high pRT. The modeling procedure applied in L2 for pRT optimization is also applicable to forthcoming products.

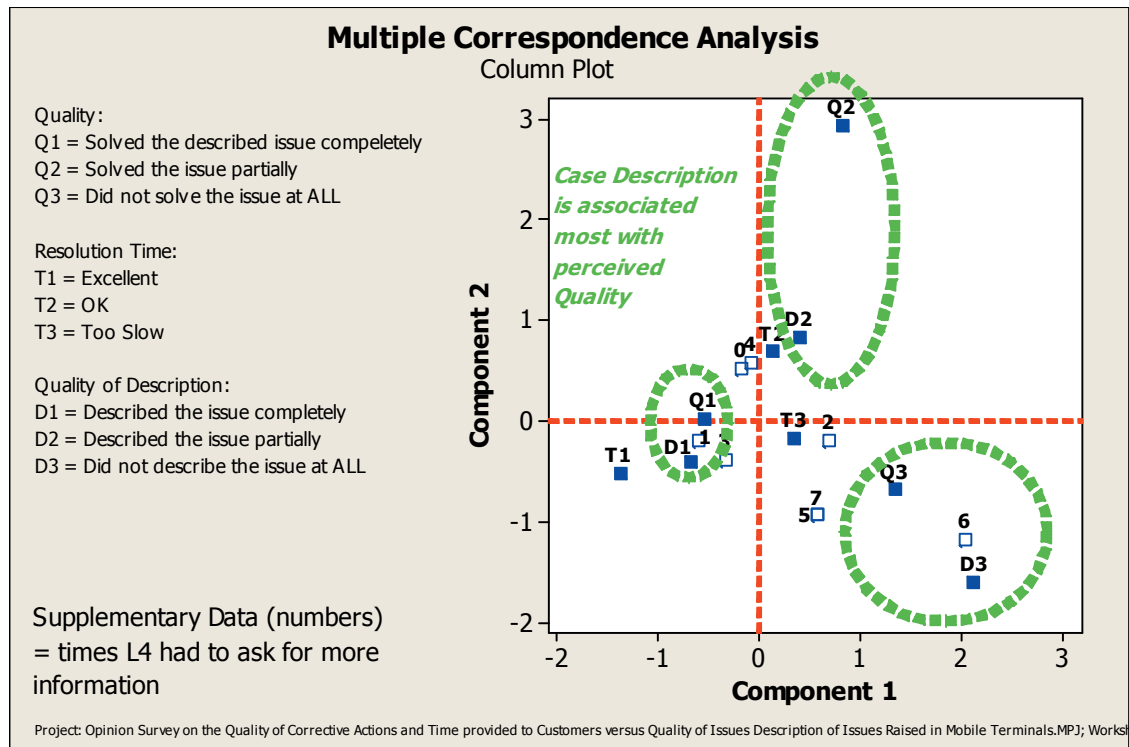
## RQ 2: What are the factors that affect P-QopS?

The answer to this question is provided primarily by article 2, which indicates that the quality of the description of a problem is associated with the perceived quality of a solution. This principle is illustrated in the principal component loading plot of solution quality (Figure 21).



**Figure 21.** Perceived quality of problem description against perceived quality of solution.

The same association was also derived from the multiple correspondence analysis illustrated in Figure 22. The problem (case) is associated with the perceived quality of a solution.



**Figure 22.** Multiple correspondence analysis.

As shown in Figure 22, **D1** (described an issue completely) and **Q1** (solved the described issue completely) are closely associated. RQ2 is also answered by the other articles, especially article 5, which indicates that training and education are required for effective handling of customer-reported problems. The rest of the articles provide relevant responses to this question (Table 1).

### **RQ 3: Can pRT be predicted?**

This question is answered by article 3. pRT is critical for customers with complaints because they want to have an idea of when their problems will be resolved. Such a prediction is equally useful for front-end customer service staffs, who interact face to face with customers, because these employees often encounter opportunities to offer an MT as a swap or loan item should the predicted pRT sufficiently warrant such a measure. Article 4 presents ways of obtaining reliable data and information on acquiring good predictive ability. The other articles provide information that is related to this question to varying degrees (Table 1).

In article 3, a prediction model equation for predicting problem resolution time (iRT is equivalent to pRT in this thesis) was established as follows:

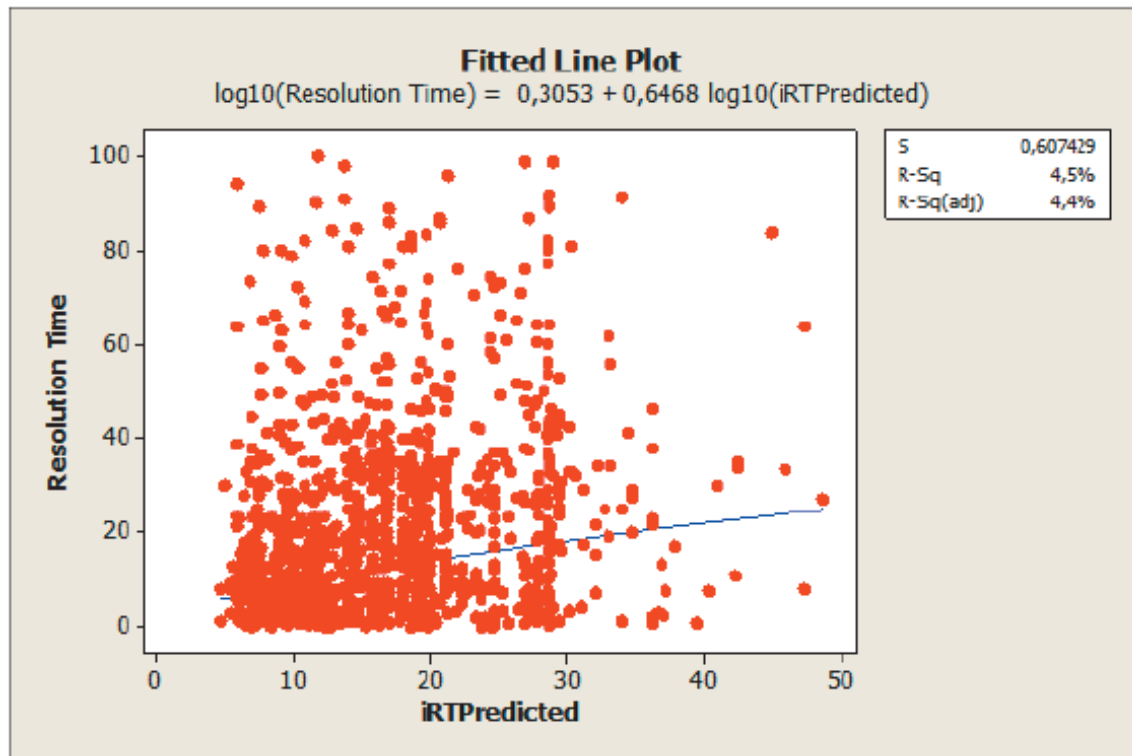
$$iRT_{predicted} = \sum(mSL1, mSL2, mSL3, mSL4) \quad (1)$$

Where mSL1, mSL2, mSL3, and mSL4 (see Figure 10, service level chain) are the predictions calculated for individual service levels.

Through regression analysis (see Figure 23), the resolution time versus  $iRT_{predicted}$  was established by the formula

$$\log_{10}(\text{Resolution Time}) = 0,3053 + 0,6468 \log_{10}(iRT_{predicted}) \quad (2)$$

S = 0,607429 R-Sq. = 4, 5%, R-Sq. (adj) = 4.4%



**Figure 23.**  $iRTPredicted$  versus actual or absolute issue resolution time (aiRT)

SL2 has the highest  $R^2_{adj}$  (17.13%) and SL3 exhibits the lowest (5.78%). The entire SL chain (i.e., SL1–SL4) exhibits the worst  $R^2_{adj}$  (4.4%). Therefore, the variable predictors selected for building the  $iRT$  model explain only 4.4% of the response variations in the model.

**Conclusion:** Given that the model explains only 4.4% of the response variations, it is unsuitable for predicting pRT. This finding suggests that variable predictors cannot sufficiently account for response variations in the data collected to build models. However, some SLs exhibit a high predictive rate, indicating that further examining predictors that may influence the prediction rate

enables the construction of a more accurate model. The method and methodology applied to research the iRT variables can be used in future when more factors concerning the parameters explaining the variables are found.

#### **RQ 4: How can the voice of ASVs for MTs be measured?**

This question is answered primarily by article 4, followed by article 5; the rest of the articles contribute to a certain extent (Table 1). Maintaining communication between MT manufacturers and ASVs is important because the failure of either party reflects on or affects the other. Communication can be measured through longitudinal questionnaire surveys, and the results can be analyzed to facilitate improvement. The cross sectional questionnaire survey conducted for article 4 reveals that ASVs are satisfied with their collaboration with MT manufacturers. Regular training sessions on new products and software updates with new tools enhance the relationship between the parties. Regular visits between the two also reinforce this relationship.

## **5.2 Theoretical and Managerial Implications**

Drawing on theory and experience, this thesis identifies practical engineering implications, specifically for handling customer problems in the after-sales phase in the MT industry. This work has analyzed the effects of the problems experienced by customers with MTs by using surveys and other statistical methods, which vary depending on type of data. The statistical models established in this work are the main contributions to existing knowledge on the AS service phase in the ICT industry. A statistical model for optimizing pRT has been established, and the model is applicable to analyzing future products. The method and methodology applied to research the pRT variables can be used in future to build a practical model for predicting pRT when more factors concerning the parameters explaining the variables are found. The association between the perceived quality of description and the perceived quality of pS has also been determined. A cross sectional questionnaire survey for ASVs was created and can be used in longitudinal surveys for panel data analysis to reveal trends and opportunities for improvement. As a managerial implication, managers should focus on organizing training on new products for both internal and external employees. To optimize the function of the entire SC, statistical modeling should be applied, from manufacturing to R&D departments.

## **5.3 Limitation and Future Work**

Given that this work examines only one MT manufacturing company, its results cannot be generalized to all MT device manufacturers. Hence, the research work described in the reviewed

articles can be regarded as case studies. Future work can include benchmark surveys for other MT device and other manufacturers of different products and service providers. Predictive variables can also be explored because this direction will facilitate the construction of a model that predicts the duration within which customer-raised problems are resolved.

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